EPA/ROD/R05-00/030
2000

EPA Superfund
Record of Decision:

SHEBOYGAN HARBOR & RIVER
EPA ID: WID980996367
OU 01
SHEBOYGAN, WI
05/12/2000

U.S. EPA SUPERFUND
RECORD OF DECISION

SHEBOYGAN RIVER AND HARBOR

SHEBOYGAN, WISCONSIN
MAY 2000

Declaration for the Record of Decision (ROD)
Sheboygan River and Harbor

A. SITE NAME AND LOCATION

Sheboygan River and Harbor
Sheboygan, Wisconsin

B. STATEMENT OF BASIS AND PURPOSE

This decision document presents the remedial action selected by U.S. EPA for the Sheboygan River and Harbor site in Sheboygan, Wisconsin. U.S. EPA selects this remedial action in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable with the National Contingency Plan (NCP). The decisions here are based on information in the administrative record for this site. However, occasionally references are made to specific documents, in the administrative record, where the information is too voluminous to provide here.

The State of Wisconsin is not expected to concur with the selected remedy.

C. ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from the site, if not addressed by implementing the response actions selected by U.S. EPA in this ROD, may present an imminent and substantial endangerment to human health, welfare, or the environment.

D. DESCRIPTION OF THE SELECTED REMEDY

The objectives of the response actions approved for this Site are to protect public health, welfare and the environment and to comply with applicable federal and state laws. The remedy outlines specific actions to address polychlorinated biphenyl (PCB) contaminated sediment, PCB-contaminated floodplain soil, and ground-water contamination.

The major components of the selected remedy include:

- Upper River sediment characterization, removal of approximately 20,774 cubic yards of PCB-contaminated sediment to achieve a soft sediment surface weighted average concentration (SWAC) of 0.5 parts per million (ppm) in the Upper River, and fish and sediment sampling to document natural processes and ensure that over time the entire river will reach an average PCB sediment concentration of 0.5 ppm or less.

- Middle River sediment characterization, removal of sediment if necessary to achieve a soft sediment SWAC of 0.5 ppm in the Middle River, and fish and sediment sampling to document natural processes and ensure that over time the entire river will reach an average PCB sediment concentration of 0.5 ppm or less.
- Lower River sediment characterization, removal of sediment if necessary to achieve a soft sediment SWAC of 0.5 ppm in the Lower River, annual bathymetry surveys to identify areas susceptible to scour, and fish and sediment sampling to document natural processes and ensure that over time the entire river will reach an average PCB sediment concentration of 0.5 ppm or less.
- Inner Harbor sediment characterization, removal of approximately 53,000 cubic yards of PCB-contaminated sediment to achieve a SWAC of 0.5 ppm in the Inner Harbor, annual bathymetry surveys to identify areas susceptible to scour, fish and sediment sampling to document natural processes and ensure that over time the entire river will reach an average PCB sediment concentration of 0.5 ppm or less, and maintenance of the outer harbor breakwalls.
- Removal of floodplain soils containing PCB concentrations above 10 ppm.
- Investigation and mitigation of potential groundwater contamination and possible continuing sources at the Tecumseh Products Company plant in Sheboygan Falls ("Tecumseh's Sheboygan Falls plant").

E. STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state applicable or relevant and appropriate requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. This remedy utilizes permanent solutions and alternative treatment technologies, to the maximum extent practicable. It does not satisfy the statutory preference for treatment that reduces toxicity, mobility, or volume through treatment as a principal element because the PCB-contaminated sediment that will be removed from the river is not anticipated to be treated prior to disposal.

Because this remedy will result in hazardous substances remaining on site at levels preventing unlimited exposure and unrestricted use after the remedial action has taken place, the five-year review requirement applies to this action.

F. DATA CERTIFICATION CHECKLIST

The following information is in the *Decision Summary* section of this ROD. Additional information is in the administrative record file for this site.

- **T** Chemicals of concern (COCs) and their respective concentrations
- **T** Baseline risk represented by the COCs
- **T** Cleanup levels established for COCs and the basis for the levels
- **T** Current and future land and ground-water use assumptions used in the baseline risk assessment and ROD

- **T** Land and ground-water use that will be available at the site as a result of the selected remedy
- **T** Estimated capital, operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected
- **T** Decisive factor(s) that led to selecting the remedy (*i.e.*, describe how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria)

5/12/2000
Date

Wm. E. Muno
William E. Muno
Superfund Division Director

TABLE OF CONTENTS

EXHIBITS

<u>COST TABLES</u>

- **Upper River Alternative 2, Natural Recovery and Disposal of CTF & SMF Sediments (detailed estimate and present worth analysis)**
- **Upper River Alternative 3-I, Sediment Removal (detailed estimate and present worth analysis)**
- **Upper River Alternative 3-II, Sediment Removal (detailed estimate and present worth analysis)**
- **Upper River Alternative 3-III, Sediment Removal (detailed estimate and present worth analysis)**
- **Upper River Alternative 3-IV, Sediment Removal (detailed estimate and present worth analysis)**
- **Upper River Alternative 3-IV-A, Sediment Removal (detailed estimate and present worth analysis)**
- **Upper River Alternative 3-V, Sediment Removal (detailed estimate and present worth analysis)**

- **Middle River Alternative 2, Characterization and Monitored Natural Processes (detailed estimate and present worth analysis)**
- **Middle River Alternative 3, Characterization, Sediment Removal and Monitored Natural Processes (detailed estimate and present worth analysis)**

- **Lower River and Inner Harbor Alternative 2, Monitored Natural Processes (detailed estimate and present worth analysis)**
- **Lower River and Inner Harbor Alternative 3, Sediment Trap (detailed estimate and present worth analysis)**
- **Lower River and Inner Harbor Alternative 4, Sediment Removal Due to Natural and Recreational Impacts (detailed estimate and present worth analysis)**
- **Lower River and Inner Harbor Alternative 5, Sediment Cap (detailed estimate and present worth analysis)**
- **Lower River and Inner Harbor Alternative 6, Surface Sediment Removal (detailed estimate and present worth analysis)**
- **Lower River and Inner Harbor Alternative 7, Complete Excavation (detailed estimate and present worth analysis)**

- **Floodplain Soil Alternative 2, Bank Soil Stabilization (detailed estimate and present worth analysis**
- **Floodplain Soil Alternative 3, Soil Removal with PCBs> 50 ppm (detailed estimate and present worth analysis**
- **Floodplain Soil Alternative 4, Soil Removal with PCBs> 10 ppm (detailed estimate and present worth analysis**

- **Groundwater Alternative 2, Investigation/Source Identification/Control (detailed estimate and present worth analysis**
- **Groundwater Alternative 3, Collection Trench (detailed estimate and present worth analysis)**
- **Groundwater Alternative 4, Cut-Off Wall (detailed estimate and present worth analysis)**

APPENDICES

Appendix A - Responsiveness Summary
Appendix B - State Letter of Non-Concurrence
Appendix C - Administrative Record Index

RECORD OF DECISION SUMMARY
SHEBOYGAN RIVER AND HARBOR
CERCLIS ID: WID 980 996 367

A. SITE NAME, LOCATION, AND BRIEF DESCRIPTION

The Sheboygan River and Harbor Site is located on the western shore of Lake Michigan approximately 55 miles north of Milwaukee, Wisconsin, in Sheboygan County.
See Figure 1 - Location Map

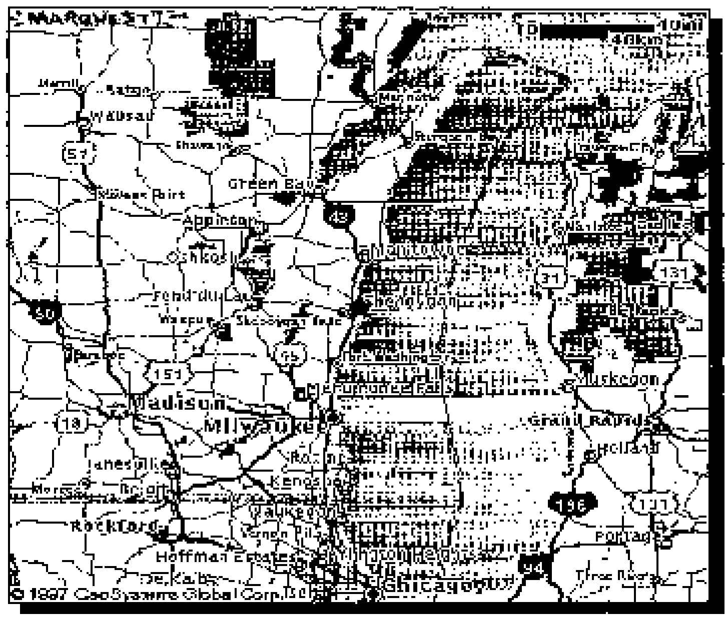

Figure 1 - Location Map

The Sheboygan River and Harbor site includes the lower 14 miles of the river from the Sheboygan Falls Dam downstream to, and including, the Inner Harbor. See Figure 2, Site Map. This segment of the river flows through Sheboygan Falls, Kohler, and Sheboygan before entering Lake Michigan. The Sheboygan River runs from west to east through east central Wisconsin, emptying into Lake Michigan.

U.S. EPA divided the river into three sections, during the remedial investigations (RI), based on physical characteristics such as average depth, width, and level of polychlorinated biphenyl (PCB) sediment contamination. The Upper River extends from the Sheboygan Falls Dam downstream 4 miles to the Waelderhaus Dam in Kohler. The Middle River extends 7 miles from the Waelderhaus Dam to the former Chicago & Northwestern (C&NW) railroad bridge. The Lower River extends 3 miles from the C&NW railroad bridge to the Pennsylvania Avenue bridge in downtown Sheboygan. The Inner Harbor includes the Sheboygan River from the Pennsylvania Avenue Bridge to the river's outlet to the Outer Harbor. The Outer Harbor is defined as the area formed by the two breakwalls.

In addition to PCB-contaminated sediment in the river and harbor, some floodplain soils are contaminated with PCBs, as seen in Figure 2. Lastly, there remain questions concerning possible ground-water contamination and additional PCB sources associated with the Tecumseh Products Company (Tecumseh) Plant, one of the three identified potentially responsible parties (PRPs) for this site. Kohler Company and Thomas Industries are the other two PRPs for the site.

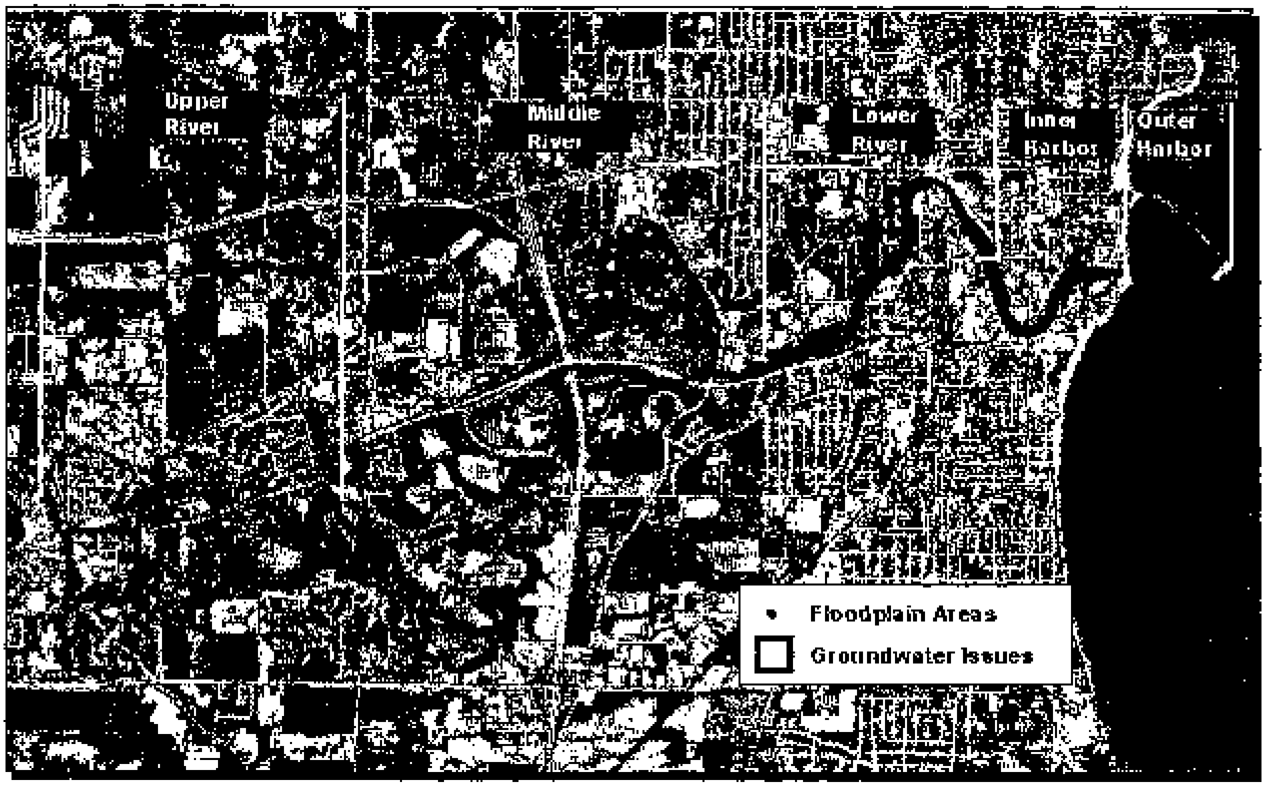

Figure 2 - Site Map

Tecumseh Products Company performed the early removal actions and the remedial investigation / feasibility study (RI/FS). U.S. EPA anticipates that one or more of the PRPs will implement the remedy.

B. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Sheboygan Harbor was constructed at the mouth of the Sheboygan River in the early 1920's. In 1954, the lower Sheboygan River, namely the channel upstream of the Eighth Street Bridge, was added as a portion of the Sheboygan Harbor for United States Army Corps of Engineers (USACE) maintenance dredging. Between 1956 and 1969, a total of 404,000 cubic yards of sediment were dredged downstream of the Eighth Street Bridge. The channel above Eighth Street has not been dredged since it was first dredged in 1956.

Prior to 1969, the USACE disposed of the dredged material from the Harbor in an authorized deep water disposal area in Lake Michigan. However, there has been no dredging within the Sheboygan Harbor since the U.S. EPA and WDNR determined that the sediment was unsuitable for open-water disposal. Sediment sampling done by the USACE in 1979, indicated moderate-to-high levels of lead, zinc, PCBs and chromium and moderate levels of arsenic present in sediment at all locations sampled. The USACE routinely removed lake sand from a sandbar that forms at the outer entrance of the Harbor. The USACE last dredged the Harbor mouth in the Fall of 1991.

In June 1979, the USACE collected 11 sediment cores from the Harbor area ranging in depth from 1.5 to 9 feet. The USACE analyzed samples for lead, zinc, copper, chromium, and PCBs. The study revealed greater PCB and metal levels in the sediment of the Inner Harbor than in sediment from the Outer Harbor. In October 1979, the USACE collected a second round of samples consisting of 21 sediment cores. The USACE's analysis of these cores generally indicated an increase in PCB concentrations with the distance upstream from the Harbor and with the depth of the sediment. The Sheboygan River and Harbor are designated an Area of Concern by the International Joint Commission on the Great Lakes due to impairment of the beneficial uses of the waterway.

Examination of 98 sediment profile samples collected by the USACE from the Sheboygan Harbor from December 2 to 6, 1982, indicated the presence of PCBs in the surface sediment of the Harbor. The possibility that this sediment may be classified as regulated material (for PCBs and metals) has contributed to the impasse of implementing an acceptable maintenance dredging effort.

Tecumseh, a manufacturer of refrigeration and air conditioning compressors and gasoline engines, is located adjacent to the Sheboygan River in Sheboygan Falls. Tecumseh is considered a PRP because PCBs were found in sewer lines that lead to the River from Tecumseh and in hydraulic fluids used in Tecumseh Products Company's Diecast Division manufacturing processes. The contamination level is high in the sediments immediately surrounding the Tecumseh Plant, but decreases in concentration downstream. Tecumseh, prior to the issuance of regulations governing PCBs, used PCB-contaminated soils to construct a dike located along the river downstream of the Sheboygan Falls Dam. Tecumseh voluntarily excavated and replaced the dike following the U.S. EPA's issuance of regulations governing PCBs in the late 1970's. Tecumseh undertook cleanup actions, but not before PCBs released into the Sheboygan River.

In 1978, the Wisconsin Department of Natural Resources (WDNR) conducted a survey that found numerous industries that discharge contaminants to the Sheboygan River. A handful had some level of PCB discharge to the river. A number of industries had heavy metals in their discharge. While heavy metals are an environmental concern, PCBs are a more significant problem and any PCB driven cleanup would address the heavy metals in the river.

In 1975 and 1976, the WDNR analyzed several industrial outfalls in the state for PCBs. From the WDNR files and the Thomas Industries response to a U.S. EPA Request for Information in 1985, two outfalls from Thomas Industries, located in the area of concern, contained PCBs when analyzed by WNDR on two different dates. The discharge to the Sheboygan Wastewater Treatment Plant contained 35.0 parts per billion (ppb) PCBs on December 3, 1975 and 1000 ppb on March 25, 1976. An outfall to the Sheboygan River via a storm sewer contained 125 ppb PCBs on June 13, 1976. Another outfall to the Sheboygan River via a storm sewer contained 125 ppb PCBs on June 13, 1975 and 88 ppb on August 19, 1975.

Thomas Industries operated an aluminum die cast shop, which has been in operation at Plant #1 since the late 1950's. The machine shop operations consisted of milling, drilling, boring and tapping of aluminum, steel, powder metal, cast iron, zinc and brass materials, and finishing and cleaning aluminum parts by acid wash, degreasing, vibratory and, spindle finishing.

Kohler Company, located in Kohler, Wisconsin downstream of Sheboygan Falls, was found to have heavy metal discharges to the river above its permit limits in the 1970's. In addition, the Kohler Landfill Superfund site is located on the banks of the river adjacent to Kohler property. The State of Wisconsin is currently overseeing the closure of that facility. There were historic releases of heavy metals and PCBs from the landfill that are currently being addressed through the facility closure plan.

U.S. EPA placed the Sheboygan River and Harbor site on the National Priorities List (NPL) in 1986.

In 1989 and 1990, U.S. EPA requested Tecumseh to conduct actions to remove about 6,000 cubic yards of contaminated sediment. This sediment was stored in two containment facilities at Tecumseh's Sheboygan Falls plant. In addition, approximately 1,200 square yards of highly contaminated sediment were capped or “armored” in place to prevent contaminants in the sediment from entering the river. Information developed during these activities is described in a document called an Alternative Specific Remedial Investigation (ASRI) report.

C. COMMUNITY PARTICIPATION

U. S. EPA places all pertinent documents related to the site in information repositories established at the Mead Public Library, 710 N. 8th St., Sheboygan and the Sheboygan City Hall, 828 Center Ave., Sheboygan. Administrative records have also been established at the Mead Public Library and the U.S. EPA Records Center, 77 W. Jackson Blvd., Chicago, Illinois.

The Region sent several fact sheets to entities on the mailing list including fact sheets dated April 1986, August 1987, Spring 1988, June 1988, June 1989, September 1989, September 1990, June 1991, February 1992, August 1992, February 1993, May 1994, December 1995, November 1998, January 1999 and July 1999.

U.S. EPA issued a Proposed Plan in May 1999, to inform the community of the proposed remedy for the site. The community was informed of a public comment period and a public meeting via the Proposed Plan and advertisements in the Sheboygan Press on May 27, and June 24, 1999. Another advertisement announcing the extension of the public comment period through August 13 appeared on June 28, 1999. The public comment period was started on June 1, 1999. On June 30, 1999, U.S. EPA sponsored a public meeting at the Mead Public Library to explain the proposed remedy, answer questions and receive public comments. A commentor requested an extension to the comment period which was granted. The entire pubic comment period lasted 75 days.

The Region held other public meetings during the RI/FS process including those on April 24, 1986, June 27,1988, Sept. 7, 1989, and September 20, 1990. The Region sent letters to the mailing list to invite local citizens and officials to a Dec. 9, 1989 tour of the dredging operation and Confined Treatment Facility. More than 60 people attended this event.

The Lake Michigan Federation received a Technical Assistance Grant in February 1994. The group used its grant to hire two advisors to assist with interpreting technical information and disseminating it to the community. A couple of newsletter articles, a fact sheet, two June 24, 1999 availability sessions and formal public comments were provided by the Lake Michigan Federation.

The public submitted approximately 200 verbal and written comments during the public comment period. The verbal comments were recorded by a court recorder at the June 30, 1999 public meeting and written comments were sent to U.S. EPA via postal mail and e-mail. A summary of public comments and U.S. EPA's responses are in Appendix A.

D. SCOPE AND ROLE OF RESPONSE ACTION

As with many Superfund sites, the problems at the Sheboygan River and Harbor site are complex. As a result, U.S. EPA has organized the site into five components.

- Upper River: Contamination of River Sediments
- Middle River: Contamination of River Sediments
- Lower River and Inner Harbor: Contamination of River Sediments
- Floodplain Soil: Contamination of River Floodplain Soil
- Tecumseh's Sheboygan Falls Plant Ground-water: Contamination of Ground-water and Additional Source Identification

Upper River

The Upper River is made up of discrete soft sediment deposits and non-soft sediment areas which include a mix of soft sediment, rocks, cobbles and bare river bottom. The sediment contamination in the Upper River acts as a source of PCB-contaminated sediment for the rest of the river system and Lake Michigan.

Middle River

The Middle River is also made up of soft and non-soft sediment areas, but due to the hydrodynamics of this stretch of the river, the areas of soft sediment are shallower and more widely scattered. Similar to the Upper River, the Middle River also acts as a source of PCB-contaminated sediment for the rest of the river system and Lake Michigan.

Lower River and Inner Harbor

Flow in the Lower River slows and a more continuous layer of soft sediment exists. The Lower River and Inner Harbor are generally where upstream soft sediment is deposited. However, while the Inner Harbor appears to be generally depositional, net deposition occurs primarily between the 8th Street Bridge and the harbor mouth. The area between the Pennsylvania Avenue and 8th Street Bridges has undergone relatively little deposition in recent years and shows evidence of scour.

Floodplain Soil

Contaminated floodplain soil is primarily located in the Upper River segment of the river. Flood events make these PCB-contaminated soils sources for the river and the animals coming in contact with contaminated surface soil. Removal of these areas will remove these current and future potential sources to the River.

Tecumseh's Sheboygan Falls plant Ground-water

Contaminated ground-water and Tecumseh's discontinued discharge sewer lines underneath the Tecumseh's Sheboygan Falls plant may pose a threat of PCB release to the River, In addition, soft sediment and river bank samples taken near the Tecumseh plant in 1999 indicated that additional PCB sources on or near the Tecumseh Products Company property likely exist.

E. SITE CHARACTERISTICS

The river is generally characterized by fast, rocky stretches in the upper reaches and slower, more sediment-laden stretches in the lower reaches. The width of the Upper River averages 120 feet and the depth ranges from 1 to 4 feet. The river widens as it approaches the harbor. Harbor water quality is a combination of near-shore lake water and water from the Sheboygan River. There is an influx of sand from the lake into the Outer Harbor caused by currents and wind-driven wave action. The extent to which this sand has deposited into the harbor has not been well established; however, it is presumably minimal due to the limited frequency of maintenance dredging by the USACE. The depth of light penetration is lowest in the river, increasing to a maximum outside the harbor. Water temperature decreases markedly from the river to the lake. Moderate levels of major nutrients (e.g., nitrate, soluble reactive phosphate, total phosphorus) are in the river and are diluted by the nutrient-poor lake water in the harbor.

Geologically, the site lies on the Lake Michigan basin and is generally underlain by glacial drift. The drift is in turn underlain by Niagaran limestone and/or dolomite. The deeper formations are the Maquoketa Shale, the Sinnipee Group, and St. Peter Sandstone. Harbor sediment consists of clay, silt, sand, and organic material underlain by dense glacial till. In many locations, the Sheboygan River has incised itself into the underlying Niagaran limestone.

Nature and Extent of Contamination

Tecumseh investigations, between 1987 and 1990, defined the nature and extent of contamination at the site and describe the extent of the threat that contaminants pose to human health and the environment. Tecumseh obtained additional data as recently as June 1999. The primary compounds of concern were determined to be PCBs, and several heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc). PCBs drive risk and, therefore, the cleanup alternatives described are primarily focused on removing PCB-contaminated sediments and soils. However, metals, volatile organic compounds (VOCs) and polynuclear aromatic hydrocarbons (PAHs) were also detected at varying concentrations.

Over the course of the investigation, Tecumseh, the Wisconsin Department of Natural Resources and the National Oceanic and Atmospheric Agency have all collected samples from the Sheboygan River.

Eight metals including cadmium, chromium, copper, lead, mercury, nickel and zinc were targeted as part of the RI. Generally, the metals occurred at relatively low concentrations in the upstream sediments and increase in the downstream sediments. Common natural elements such as aluminum, calcium, iron, magnesium, potassium, and sodium are also present.

Sampling detected five VOCs, including methylene chloride, acetone, chloroform, methyl ethyl ketone, and toluene in the river sediments. VOCs were generally found in low concentrations in the river sediment. However, acetone was detected at levels up to 270 ppb, while toluene was detected at levels up to 740 ppb.

PAHs are commonly associated with petroleum products, waste oil, and coal tars. During the RI the total estimated PAH concentrations were at, or below, 2.0 ppm for nine of the ten river samples obtained. The tenth sample had a PAH concentration of 4 ppm. In 1998, PAH sampling conducted by the Wisconsin Public Service Corporation for a project managed by the Wisconsin Department of Natural Resources showed total PAH concentrations from non-detect to 9,294 ppm near the former Manufacturing Gas Plant site in the Lower River, just upstream of the Pennsylvania Avenue Bridge. Additional investigations and future potential remediation of PAH contaminated sediments related to this effort is being managed separately by the Wisconsin Department of Natural Resources and will not be a part of this Record of Decision.

No pesticides or dioxin/dibenzofurans were detected in the river sediments.

Table 1 - Metals Contamination (ppm)				
	Upper, Middle & Lower River		Inner Harbor	
	Minimum	Maximum	Minimum	Maximum
Arsenic	1.2	16	0.7	20.4
Cadmium	ND	3.1	ND	3.7
Chromium	ND	143	2.2	414
Copper	ND	102	ND	140
Lead	3.6	293	1.1	783
Mercury	ND	0.3	ND	0.1
Nickel	ND	90	ND	354
Zinc	ND	300	ND	369

ND - Non Detected

See the May 1990 “Remedial Investigation/Enhanced Screening Report” for more detailed information relating to metals, VOCs and PAHs in their locations in the river or harbor.

PCB-Contaminated Sediment

Upper River

PCB sampling results in 1989 and 1990 showed concentrations from 1.4 to 4,500 ppm. Tecumseh removed PCB-contaminated sediment near its facility in 1990 and 1991. PCB sampling conducted in December 1997, from the same soft sediment areas sampled in 1989 and 1990 shows concentrations ranging from non-detect to 170 ppm. Soft sediment sampling in 1999, near Tecumseh's Sheboygan Falls plant, revealed PCB concentrations as high as 840 ppm. River bank sampling in 1999, near Tecumseh's Sheboygan Falls plant, revealed PCB concentrations as high as 1,100 ppm. PCB-contaminated sediment in this segment of the river migrates downstream due to the dynamic nature of this river reach.

Middle River

Information obtained during the RI showed PCB concentrations ranging from nondetect to 8.8 ppm. WDNR sediment trap data showed PCB concentrations ranging from 1.4 to 3.0 ppm. The WDNR obtained sediment trap data between 1990 and 1996. Samples obtained in 1997 by WDNR show PCB concentrations ranging from 0.6 ppm to 37 ppm. Like the Upper River, sediment in the Middle River is likely to be disturbed due to the dynamic nature of this river reach.

Lower River

During the original site investigations, sampling shows PCB concentrations as high at 67 ppm in the Camp Marina area just a couple of feet below the sediment surface. Contaminated sediments within the top two feet may be disturbed by high flow events and/or boating. WDNR sediment trap data, from 1994 to 1996, shows PCB concentrations ranging from 1.9 to 4.2 ppm in the Lower River.

Inner Harbor

RI sampling detected PCB concentrations as high as 220 ppm in the Inner Harbor, however these levels were detected in 1979 and remain many feet below the surface. PCB surface sampling results (top 6 inches) in 1987 ranged from 0.17 to 5.8 ppm. PCB surface sampling (top 6 inches) results in 1999 range from 0.38 to 5.3 ppm. Table 2 shows the average, minimum, and maximum concentration of PCBs in the top 6 feet of sediment based on all sediment data adjusted to the 1999 bathymetry and extrapolated by Earth Vision software. As a general rule, PCB concentrations increase with depth between the 8th Street Bridge and the Inner Harbor mouth. This, however, is not the case for certain areas between the Pennsylvania Avenue and 8th Street Bridges.

Table 2 - Inner Harbor Sediment Concentrations (ppm)

Sediment Depth	Average	Minimum	Maximum
Top 1 foot	5.6	ND	117.4
1 to 2 feet	7.9	ND	89.1
2 to 4 feet	10.7	ND	103.2
4 to 6 feet	13.6	ND	82.49

Soil

Tecumseh collected soil samples from within the 10 year floodplain of the Sheboygan River during the investigation phase of the project. Floodplain samples collected in 1990 showed PCB concentrations ranging from non-detect to 71 ppm. Tecumseh took additional rounds of samples as part of the Alternative Specific Remedial Investigation (ASRI) in 1990 and 1992. PCB concentrations exceeded 50 ppm in two samples and 10 ppm in six samples. Sampling in floodplain area 11 shows a concentration of 220 ppm. Floodplain area 11 was resampled in 1992 and shows PCB concentrations of 330 and 320 ppm. PCB concentrations have decreased in floodplain area 11 since the ASRI sampling due to disturbances of the floodplain caused by golf course construction by the land owner.

Surface Water

PCB concentration were detected in surface water prior to, during and after implementation of the PCB removal action in 1989 and 1990. The result are shown Table 3.

Table 3 - Surface Water Samples

	PCB Concentration (ppb)	
Date	Minimum	Maximum
April 1989	0.044	0.127
July 1989	< 0.05	0.52
November 1990	< 0.05	0.77
April 1991	< 0.05	0.08
July 1991	< 0.05	0.32
September 1991	< 0.05	0.22
October 1991	< 0.05	< 0.05
April 1992	< 0.05	< 0.05
July 1992	< 0.05	0.36
October 1992	< 0.05	0.13
May 1993	< 0.05	0.08

Ground-water

PCB contamination is also present in ground-water at the Tecumseh plant. Ground-water sampling conducted in September 1992 and May 1993 by Tecumseh indicated that PCBs were locally present in the Tecumseh's Sheboygan Falls plant ground-water in concentrations ranging from 0. 10 ug/L to 7.4 ug/L (unfiltered) and below the detection limit [0.05 ug/L] to 0.89 ug/L (filtered). These concentration standard for ground-water.

Tecumseh estimated that the resulting flux of PCBs to the Sheboygan River was 0.4 grams/year. In a February 1998, letter to Tecumseh, the WDNR indicated that the flux could range from 0.4 to 280 gram/year, depending on the selection of input variables. Whether 0.4 or 280 grams/year, all flux calculations are conservative in that PCB retardation was not included. Given the high adsorption of PCBs to solids, the transport velocity of PCBs in ground-water is likely to be low. However, preferential pathways for flows, such as those that have been identified since the Feasibility Study was done, can greatly reduce the amount of travel time for PCB-contaminated groundwater to travel to the river. River bank samples that Tecumseh collected in 1999, near their Sheboygan Falls plant show PCB concentrations as high as 2,700 ppm where previous removal actions should have addressed concentrations of this magnitude. This PCB concentration was near a non-contact cooling water pipe outfall. Therefore, additional investigations near Tecumseh's Sheboygan Falls plant are needed to characterize any possible continuing sources, including preferential pathways, of PCBs to the Sheboygan River.

With respect to potential exposure to PCB-contaminated ground-water at Tecumseh's Sheboygan Falls plant, there are no water supply wells at the plant. Also, an existing City of Sheboygan Falls ordinance prohibits the use of private water supply wells except by permit. To prevent potential future plant personnel from using and directly contacting the PCB-contaminated ground-water, deed restrictions must be placed on Tecumseh's Sheboygan Falls plant property to prevent the installation and development of water supply wells.

Fish and Wildlife

Tecumseh collected fish tissue samples between 1990 and 1998, that show smallmouth bass and white sucker PCB concentrations ranging from 1.3 ppm to 23.1 ppm. Carp had PCB levels ranging from 10.5 to 200 ppm. In general, the highest fish tissue PCB concentrations were found nearest the Tecumseh plant and tend to decrease downstream. Fish taken from the Sheboygan River between the Sheboygan Falls dam and the mouth of the river fall into the “do not eat” consumption advisory category, and waterfowl consumption advisories are in place for some waterfowl species from the Sheboygan River below Sheboygan Falls dam to the Sheboygan harbor.

PCB concentrations in wild birds collected between 1976 and 1980 ranged from 2 to 213 ppm. In 1985 and 1986, Tecumseh monitored wildlife again for PCBs including several species of waterfowl. These analyses resulted in consumption advisories for mallards and lesser scaup in the Sheboygan River area of concern in 1987.

Fish and waterfowl advisories are for the entire 14-mile stretch from Sheboygan Falls to Lake Michigan.

F. CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

Land Uses

Land use along the Upper River is industrial, residential and recreational in Sheboygan Falls. The Kohler Company owns land adjacent to the Middle River in the Village of Kohler. Land use in the Middle River consists of a horse farm, tree nursery, the company's historic River Bend property and the BlackWolf Run golf course. The 800-acre, Kohler-owned River Wildlife Area is on the south side of the river adjacent to the Upper and Middle River. The wildlife area is used as a private hunting and fishing club. Land use adjacent to the Lower River and Inner Harbor is recreational, commercial and industrial with some residential areas. The City of Sheboygan's central business district is on the north bank of the of the river in the harbor area. The City is presently revitalizing the harbor area. Offices, restaurants, marinas, parks and a boardwalk are part of this plan.

Surface Water / Ground-Water Uses

There are no public beaches along the river or harbor. The Lower River and harbor are navigable, but Upper and Middle River traffic is typically restricted to smaller craft (i.e. canoes and kayaks) which can be portaged around the dams in Kohler and Sheboygan Falls, as well as shallow areas. Public and recreational boat access is available at a number of locations within the city of Sheboygan in the Lower River and harbor. There is considerable seasonal fishing in the Middle River, Lower River and Inner Harbor. Fishing is more limited in the Upper River. According to WDNR surveys, most fishing occurs during spring and fall salmon and trout runs. A fish consumption advisory is in effect for Sheboygan River and Lake Michigan fish.

The Sheboygan River is not used as a public water supply, but it drains into Lake Michigan which is used as a drinking water source by Sheboygan, Sheboygan Falls, and Kohler. The three cities regularly test the public water and it is safe to drink. Contaminated ground-water near Tecumseh's Sheboygan Falls plant is not used as a drinking water source.

G. SUMMARY OF SITE RISKS

The risk assessment estimates what risks the site poses, if no action was taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action.

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen.

Excess lifetime cancer risk is calculated from the following equation:

$$\text{Risk} = \text{CDI} \times \text{SF}$$

where:

> risk = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer
> CDI = chronic daily intake averaged over 30 years (mg/kg-day)
> SF= slope factor, expressed as $(\text{mg/kg-day})^{-1}$.

These risks are probabilities that usually are expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in a million chance of developing cancer as a result of site-related exposure. This is referenced as an “excess lifetime cancer risk” because it would be in addition to the risks of cancer individuals face from other cancer causes such as smoking or exposure to too much sun. The chance of an individual developing cancer from all other causes has been estimated to be as high as one in three. EPA’s generally acceptable risk range for site related exposures is 10^{-4} to 10^{-6} (1 in ten thousand to 1 in a million).

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., lifetime) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effects. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ<1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic non-carcinogenic effects from that chemical are unlikely. The Hazard index (HI) is generated by adding the HQs for all chemicals of concern that affect the same target organ (e.g., liver) within a medium or across all media to which a given population may reasonably be exposed. An HI<1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI>1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

$$\text{Non-cancer HQ} = \text{CDI} / \text{RfD}$$

where:

CDI = Chronic daily intake
RfD - reference dose

CDI and RfD are expressed in the same units and represent the same exposure period

A site conceptual model showing the potential exposure pathways can be seen in Figure 3.

<u>Human Health Risks</u>

A number of human health risk analyses have been performed for the site:

- Baseline Risk Analysis 7/96
- Cleanup Goal Analyses 10/98 (revised 12/99)
- Other assessments: GLNPO-ARCS 1993, Environ 1995, Endangerment assessment by Blasland and Bouck (1990)

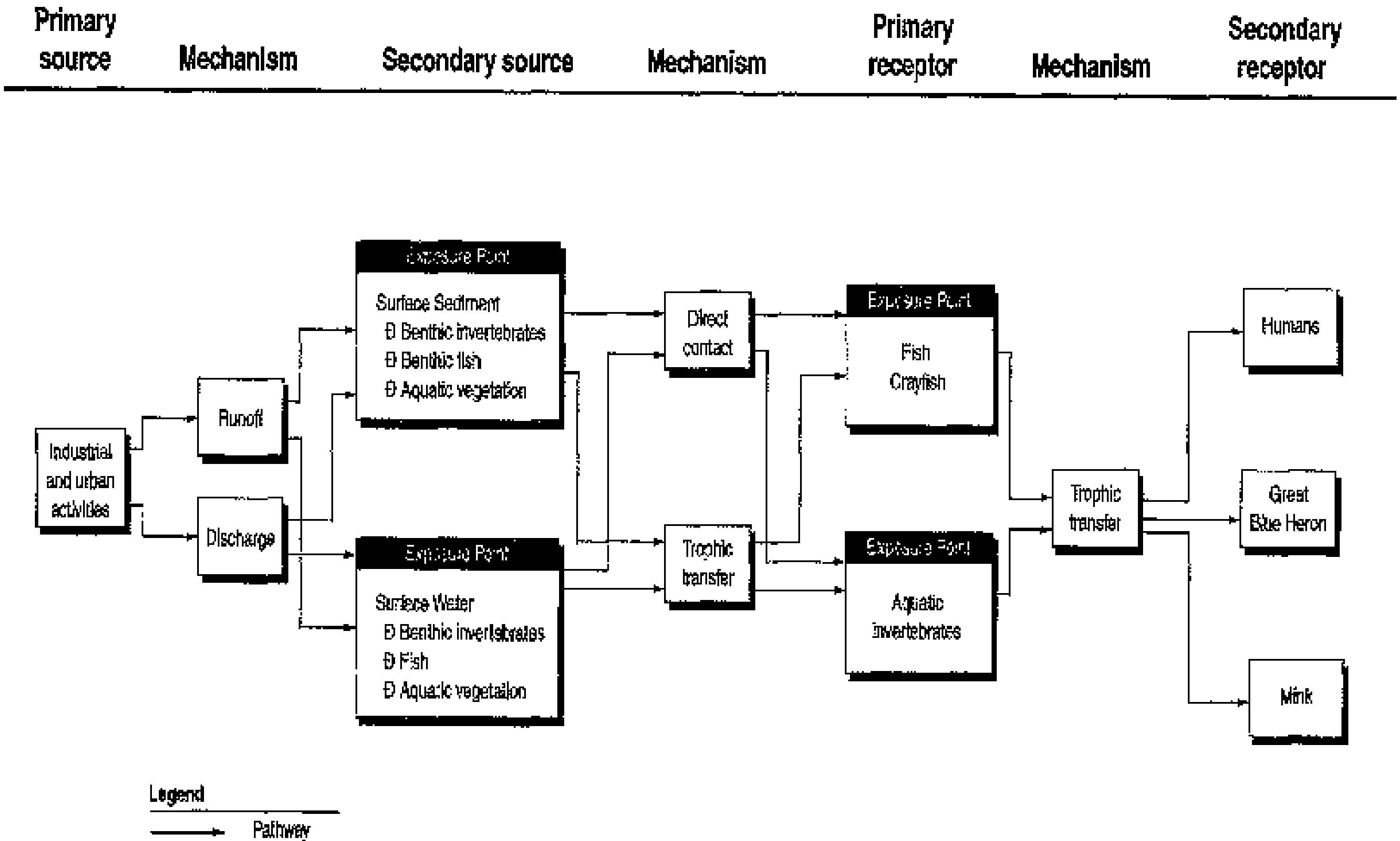

Figure 3. Sheboygan River and Harbor Potential exposure pathways

Contaminants of Concern

With regards to human health risk, the main contaminant of concern is PCBs. The other contaminants of concern at the site, such as some metals, are not at levels of concern to the degree that PCBs are. While metals do present a risk, that risk will be reduced through the removal of PCB-contaminated sediments. In addition, some metals are not as bioaccumulative and persistent as PCBs. The risk driver and most prominent contaminant of concern for this site is PCBs.

In addition, the risk analysis quantitatively considered *only* the non-dioxin-like PCBs. Although this limits the analysis, U.S. EPA decided to limit the quantitative risk analysis to PCB-like congeners because the available congener data was only available at a few locations. A more qualitative assessment revealed that the dioxin-like congeners did not represent a significant increase in risks over risks estimated using total PCBs and Aroclor data.

Exposure Assessment

The physical setting of the site provides several possible pathways of exposure to the contamination in the sediment: dermal contact, ingestion of contaminated surface water or sediment, and consumption of fish contaminated by sediment. The sediments are contaminated with PCBs, hydrophobic organic compounds that will strongly prefer to partition to organic material. It is assumed then, that the most significant exposure is from contaminated sediment, where virtually all PCBs reside, and not the surface water. In general, there is likely to be only limited direct contact with the sediment itself (i.e., dermal and/or ingestion pathway). Many studies have found that *bioaccumulation* of hydrophobic organic sediment contaminants is the critical and dominant fate of these compounds in the environment. Based upon the above, the human health analysis assumes that for this Site, the pathway presenting the majority of the risk and likely to yield the most protective assessment of risks is consumption of contaminated fish and not dermal contact.

This does not imply that no other exposure pathways are occurring at this site, only that there is a focus on the pathway which contributes the majority of risk, the fish ingestion pathway. Other pathways clearly are occurring, such as exposure to the floodplain soils.

Toxicity

The principal source of toxicity information for use in risk assessments is U.S. EPA's Integrated Risk Information system, or IRIS. IRIS values represent consensus-based information for use agency-wide.

PCBs are classified as probable human carcinogens based on conclusive evidence in animal studies and limited evidence in human studies. Animal studies found that in several strains of mice and rats, PCBs induced hepatocellular carcinomas. In human studies, the findings suggest an increased chance of cancer via ingestion, inhalation and dermal contact. The cancer slope factor for PCBs, as obtained from IRIS is 2 mg/kg-day, for bioaccumulative pathways, such as sediment contamination and fish ingestion. A slope factor for assessing cancer risks assumes that cancer risk is probabilistic and any degree of exposure leads to some degree of risk. A slope factor relates estimated exposures to incremental lifetime cancer risks, and therefore the result is a probability of cancer over the background levels in the population. For example, a risk result of 7×10^{-4} is equivalent to saying there is an increased cancer risk at a rate of 7 in 10,000 people.

PCBs have also been reported to exert non-cancer effects. PCBs (specifically Aroclor 1254) have been shown to suppress the immune system, based on studies in rhesus monkeys. This information was used to develop a Reference Dose (RfD), which is 2×10^{-5} in IRIS. Additionally, Aroclor 1016 has been shown to exert developmental effects in monkeys (decreased birth weights). This value is 7×10^{-5}. An RfD indicates a safe level exposure, meaning that exposure at the RfD level is likely to be without an appreciable risk of deleterious effects. To assess non-cancer risks, a hazard index of the estimated exposure over the RfD is calculated. Because the RfD represents a safe level, the hazard index should be one, or less than one, to be protective of human health. The higher the hazard index, the higher the likelihood of effects.

Baseline Risks at the Site

In 1996, U.S. EPA performed a baseline risk assessment for the Site, relying on data available from WDNR on fish tissue concentrations in 1994. Table 4 lists the exposure assumptions used in the 1996 baseline risk assessment. U.S. EPA assessed in the analysis; sport fishing and subsistence fishing. The sport fishing scenario was developed to represent a mid-point or central tendency estimate of risk, and the subsistence fishing scenario was developed to represent an upper-bound estimate of risk. The sport fishing scenario variables were chosen to be reasonable, and not overly conservative in their assumptions. U.S. EPA used Great Lakes specific fish consumption information, available in West study's assessment of Michigan anglers (1989 and 1993). It was assumed that of the total amount of fish consumed, only half of the fish came from the Sheboygan River. This is accounted for in the fraction ingested term. And for the upper-bound subsistence scenario, we used a conservative estimate of all fish ingested coming from the Sheboygan River.

The baseline assessment relied upon fish data from WDNR, taken in 1994, including small mouth bass, catfish, and pike species results. Other fish data have been collected in the past, but the most recent data at the time was selected for this assessment because they were considered to be extensive and current.

Migratory fish data were also considered. Salmon and steelhead data were obtained by Blasland, Bouck, and Lee and were also presented in the Environ risk assessment. Migratory species differ from resident fish in that resident fish tend to bioaccumulate greater amounts of PCBs from this Site. These migratory fish data were considered because they are consumed by fishers of the river and would therefore help to provide the most complete account of health risks at the Site.

To best assess exposure, we consulted the Wisconsin Department of Health and Social Services (WDH) and WDNR to provide insight and information on the various exposed populations on the river. In addition, we consulted data used in developing the other assessments listed above.

<u>Risk Characterization of Baseline Risks at the Site</u>

The risk assessment used two sets of exposure assumptions to assess risk; in general they were developed to assess “average” fishing [central tendency] and subsistence fishing consumption. The assumptions used are listed in Table 4. In general, the subsistence consumption scenario is a very high-end exposure; an individual is getting almost all of his protein from fish, these fish are from Sheboygan only, and the person is fishing in Sheboygan over a 30 year period. However, information obtained through personal communications with WDH and in the Environ Fish Consumption Study indicate that there are some individuals in the Sheboygan River who match this exposure scenario. Alternatively, the assumptions used to shape the “average” scenario are: an individual fishing a few months a year, getting a portion (25%) of his fish from the Sheboygan River, for a period of 30 years.

Note that migratory species like salmon and steelhead were also assessed in order to give the fullest picture of risks occurring for Sheboygan fishers. It is understood that migratory species will be exposed to a wider range of sediment than a resident fish, and therefore not all contamination in these migratory species may attributable to this particular Site.

For all species and for all exposures scenarios, cancer risks were of significant concern. Even the *central* tendency

<u>TABLE 4. Assumptions Used in 1996 Risk Assessment</u>

Cancer	sport (central tendency)	subsistence (high end)	**Non-Cancer**	sport (central tendency	subsistence (high end)
cancer slope factor	2	2	Ref. Dose	2.0×10^{-05}	2.0×10^{-05}
Body weight (kg)	670	70		70	70
Average time (days)	25550	25550		10950	10950
Ingestion rate (kg/day)	0.02	0.13		0.02	0.13
Fraction Ingestion (%)	0.25	1		0.25	1
Absorption (%)	1	1		1	1
Exp. Frequency (days/year)	365	365		365	365
Exposure duration (years)	30	30		30	30
Concentration in Fish	*species specific*	*species specific*		*species specific*	*species specific*

estimates of risks are of concern. The subsistence fishers, or anyone eating greater amounts of fish than the average fisher, would have even greater risks, with possible increases of an order of magnitude or more.

In order to summarize all of the risk information at the site, we compiled Table 5, to show major conclusions from several of the risk assessments done over the years (from U.S. EPA Risk Analysis 1996). Table 5 demonstrates that even with different authors and different exposure assumptions, a range of risks are present at the site due to consumption of contaminated fish.

Table 5. Comparison of Risk Estimates

Comparison of Cancer Risk Estimates from Various Assessments	U.S. EPA, 1996	Environ, 1995	GLNPO-ARCS, 1993	Baseline Assessment in RI, 1990
Key Assumptions	-19 - 65 g/day of fish -25% - 100% is from Sheboygan River	-percentiles of distribution of risks are shown (results of probabillistic analysis) given by each area -bass, carp, salmon and steelhead assessed	-19, 54 and 130 g/day of fish -5, 10, and 20% is from Sheboygan River	-20 g/day of fish -50% from Sheboygan -salmon and trout assessed
	-pike, catfish, salmon, steelhead, bass assessed		-salmon, steelhead, bass and carp assessed	
Cancer risk estimates	"average" - $1x10^{-4}$ to $1x10^{-5}$ subsistence - $1X10^{-2}$ to $1x10^{-4}$	-50th ple. $-1x10^{-6}$ -70th ple. - $1x10^{-5}$ (values are for Areas 1 & 3 each)	$1x10^{-3}$ to $1x10^{-6}$	$1x10^{-2}$ to $1x10^{-3}$

<u>Cleanup Goal Analysis - Surface Goals for the Sediment</u>

In order to address unacceptable risks at the site, U.S. EPA calculated sediment cleanup goals, protective of human health. For this analysis, *three* types of fish consumption patterns were used. Appropriate ingestion rates for these fish consumption patterns were based on the extensive survey of Michigan anglers done by West *et al* (1989 and 1993) to develop an appropriate set of ingestion rates. For the central tendency estimate, 19 grams a day (with a frequency of 365 days per year) was used and is approximately the 50^{th} percentile of fish consumption from the '93 West study, and is *higher* than the 50^{th} percentiles of both the '89 study and the average of the 50^{th} percentiles from both studies, by about 5 grams. For the reasonable maximum exposure (RME) scenario, 54 grams a day was used (with a frequency of 365 days a (year) which is the 90th percentile of the ‘93 study and close to the 95th percentile of the average of the two studies, and much higher than the 95th percentile of the ‘89 study which was 39 grams a day. For the upper bound or high end consumption estimate, U.S. EPA utilized a study by Pao, that yielded a maximum value over a three day period and applied it to a year round exposure to estimate a subsistence scenario.

The fraction ingested term, or how much fish is consumed comes from the Sheboygan River, for each of the scenarios was: 25% in the central tendency scenario, 50% for the RME, and 100% for subsistence. The fraction ingested term for the central tendency and RME reflects the expectation that some anglers consume fish from water bodies other than the Sheboygan River.

An ATSDR/WDH study (May 1998) looked at where anglers caught fish in the Sheboygan area. The total number of meals estimated to be eaten by anglers from the Sheboygan River was 37 per year, while very stringent fish consumption advisories were in place for the Sheboygan River. The RME scenario estimates 43 meals a year which allows for increased fish consumption as advisories are reduced and is consistent with the potential fishery production of the Sheboygan River. The RME becomes the point of departure for risk management purposes pursuant to Agency risk guidance. See Table 6 for a complete list of exposure assumptions used in all three scenarios.

Consistent with U.S. EPA risk assessment guidance, actions at Superfund sites should be based on an estimate of the RME expected to occur under both current and future conditions. In the past, exposures generally were estimated for an average and upper-bound exposure case. The advantage of the two exposures is that they provide some measure of the uncertainty surrounding these estimates. The disadvantage of this approach is that the upper-bound estimate of exposure may be above the range of possible exposures, whereas the average estimate is lower than exposures potentially experienced by much of the population. The intent of the RME is to estimate a conservative exposure case (i.e., well above the average case) that is still within the range of possible exposures.

U.S. EPA made a conscious decision to model and be protective of the more contaminated resident fish species of smallmouth bass and carp at the site. By selecting a cleanup goal protective of bass (or carp), the cleanup will be protective of the lesser contaminated species such as walleye, trout, salmon and steelhead. This choice adds a layer of conservatism to allow for more fish consumption at the site, especially of several non-resident species. Therefore, a cleanup based on resident species may allow for possibly *more* consumption of other types of fish (greater than 54 grams per day or 43 fish meals per year from the Sheboygan River) that may occur as advisories are lifted.

Using the acceptable risk value of 10^{-6}, or 1 in 1,000,000, the range of target fish levels is quite low. The value of 0.0005 ppm in fish is protective of the upper bound estimate of subsistence fishers. This scenario relates to an individual who gets all of the protein in his diet from Sheboygan, year-round, for 70 years. For the central tendency scenario (or about half of the fishing population), the target fish concentration is 0.016 ppm. The RME scenario provides a target fish tissue level of 0.003 ppm to be protective of the 90^{th} - 95^{th} percentile of the fishing population over a 30 year period. Examples of fish cleanup goals for different risk points are a 10^{-5} level for the RME would be 0.03 ppm and a 10^{-4} level for RME would be 0.3 ppm.

To calculate a sediment cleanup goal or surface goal, these target fish tissue levels are placed into a Biota to Sediment Accumulation Factor (BSAF) equation to estimate the sediment concentrations that would meet these fish targets. The term “surface goal” is more appropriate, for the Sheboygan site, than the usual cleanup goal, because what is calculated is a surface that the fish can be exposed to that will result in the target fish tissue levels. Looking at the site, it’s necessary to calculate what the residual concentration is after dredging certain levels, or what’s left after taking out everything above a certain concentration. In the case of the Sheboygan, it’s the target surface weighted average concentration, or SWAC, of the river after remediation.

To develop cleanup goals for dioxin-like PCBs and non-dioxin-like PCBs it requires much more information on where these PCB congeners are distributed and the total organic carbon levels associated with them. This information was not available. Dioxin-like PCB cleanup goals would also require a more complex assessment of toxicity.

There were concerns with how to interpret risks generated by two separate means. One estimate is derived using a total PCB slope factor (which may include some dioxin-like congeners) and then a separate risk estimate would be generated using congener-based toxicity equivalency factors or TEFs with the dioxin slope factor. It is not clear whether risks would be over- or under-rep resented and given the incomplete data set, the uncertainties were considered too large to provide a clear and *quantitative* picture of dioxin-like PCBs at the site for human health.

<u>Bioaccumulation Model</u>

Reduced PCB levels in sediment are necessary to achieve the target fish tissue levels. To translate from the target fish tissue levels to sediment levels, a bioaccumulation model is utilized. For this site, the BSAF model was used. The methodology is the same as used in the Ecological Risk Assessment and is similar to what was used in the PRP RI/FS, except U.S. EPA risk assessments include TOC and lipid in the calculation.

Note that BSAFs were only calculated for small mouth bass and carp and not the lesser contaminated migratory species of salmon and steelhead, to provide protection for anglers who consume several different species of fish. BSAFs were calculated for small mouth bass because of their prevalence in the river and for carp as an indicator of concentrations in fish with higher lipid levels.

Table 6. Assumptions Used in Deriving Fish Tissue Levels for Sediment Cleanup Goals

Cancer (10^{-6})	sport (central tendency)	RME	subsistence (high end)	**Non-Cancer** (HI=1)	sport (central tendency)	RME	subsistence (high end)
cancer slope factor	2	2	2	Ref. Dose	2.0×10^{-05}	2.0×10^{-05}	2.0×10^{-05}
Body weight (kg)	70	70	70		70	70	70
Averaging time (days)	25550	25550	25550		10950	10950	10950
Ingestion rate (kg/day)	0.02	.054	0.13		0.02	.054	0.13
Fraction Ingested (%)	0.25	.5*	1		0.25	.5*	1
Absorption (%)	1	1	1		1	1	1
Exp. Frequency (days/year)	365	365	365		365	365	365
Exposure duration (years)	30	30	70		30	30	70
Concentration in Fish, ppm	**.016**	**.003**	**.0003**		**.28**	**.05**	**.01**

* Assumes a consumption scenario with 50% of the fish coming from the Sheboygan River. Assuming 100% consumption from the Sheboygan River with a contaminant reduction factor of 50% based on Great Lakes Fish Consumption Protocol results in the same fish concentration.

The analysis begins by calculating a site-specific BSAF using PCBs in sediment, TOC, PCBs in fish and lipid data. However, because the data in the RI/FS are given as summary statistics, the U.S. EPA could not derive its own sediment surface area weighted PCB that is normalized to TOC. This term is necessary for the BSAF model. Therefore, the SWAC derived in the RI/FS is not useable in calculating a site-specific BSAF. Because the NOAA ecological risk assessment, for the site, also developed BSAFs, U.S. EPA considered the NOAA BSAFs, and found that they were quite similar to the human health based BSAFs.

Table 7. BSAF Terms Used in Deriving a Sediment Cleanup Goal
(RME scenario shown)

Sediment Cleanup Goal -> Conc. Sediment = (TOC X Conc. Fish) / (site specific BSAF X % lipid)

	Conc. Fish [1] (ppm)	TOC [2] (%)	BSAF [3]	Lipid [4] (%)	Conc. Sed. (ppm)
Bass	0.003	5.3	4.54	0.715	**0.005**
Carp	0.003	5.3	4.62	5.927	**0.0006**

1 The concentration in fish is shown for the RME fishing scenario, at a 10^{-6} level of risk
2 5.3 is the geometric mean of all the 1997 TOC data from NOAA Aquatic Ecological Risk Assessment
3 The site-specific BSAFs are derived from the following values: RI/FS total river bed SWAC, and NOAA Risk Assessment TOC (1997), and 1994 fish data (from FIELDS database)
4 The mean lipid percentages, for each species, in 1994 (from FIELDS database)

Note, to determine a 10^{-5} or 10^{-4} protective surface goal, simply move the decimal over; so a cleanup goal for a 10^{-4} risk for bass would be 0.5 ppm.

Table 8 shows what the PCB sediment concentrations need to be for either bass or carp consumption for various cancer and non-cancer risk levels.

Table 8. Sediment Cleanup Goal Summary Tables

Central Tendency Sport Fishing Scenario (20 g/day, 25% ingestion from Sheboygan, 30 years		**Sediment Cleanup Goal in ppm, based on consumption of Bass**	**Sediment Cleanup Goal in ppm, based on consumption of Carp**
Cancer	10^{-6}	0.027	0.0032
	10^{-5}	0.27	0.032
	10^{-4}	2.7	0.32
Non-Cancer (Immune effects)			
Hazard Index = 1		0.46	0.054
Hazard Index = 10		4.6	0.54

RME Scenario (54 g/day, 50% ingestion from Sheboygan, for 30 years)		**Sediment Cleanup Goal in ppm, based on consumption of Bass**	**Sediment Cleanup Goal in ppm, based on consumption of Carp**
Cancer	10^{-6}	0.005	0.0006
	10^{-5}	0.05	0.006
	10^{-4}	0.5	0.06
Non-Cancer (Immune effects)			
Hazard Index = 1		0.085	0.01
Hazard Index = 10		0.85	0.1

High End Subsistence Scenario (130 g/day, all ingestion from Sheboygan, for 70 years		**Sediment Cleanup Goal in ppm, based on consumption of <u>Bass</u>**	**Sediment Cleanup Goal in ppm, based on consumption of <u>Carp</u>**
Cancer	10^{-6}	0.0005	0.0001
	10^{-5}	***0.005****	0.001
	10^{-4}	0.05	0.01
Non-Cancer (Immune effects)			
Hazard Index = 1		0.018	0.0021
Hazard Index = 10		0.18	0.021

****This cleanup level is less than. 011 which is generally equivalent to a cleanup goal that's generated using fish advisory goals of 50 ppb PCBs in fish tissue.***

Therefore, using the cleanup goal summary tables and post-remedial risk analysis, an appropriate human health cleanup goal, based on the consumption of bass under the RME, would range from 0.005 ppm which equals a 1 in a million risk to 0.5 ppm which would equal a 1 in ten thousand risk. The 10^{-6}, or 1 in a million, risk level is the departure point for managing site risks.

<u>Ecological Risks</u>

<u>Aquatic Risk Assessment</u>

The focus of the NOAA Aquatic Risk Assessment is to estimate the present level of risk to the aquatic organisms and piscivorus birds and mammals of the Sheboygan River and Harbor from exposure to contaminated sediments, water, and biota. To estimate risk, tissue and sediment data from recent studies, including the 1994&1995 Sheboygan River food chain and sediment contaminant assessment conducted by the WDNR and data collected specifically for this aquatic risk assessment were evaluated. In addition, other relevant data collected on Sheboygan ecological communities by WDNR in recent years are included to provide an overall context for the aquatic risk assessment. Thus, the recommendations made by NOAA regarding protective sediment concentrations and future monitoring needs reflect what is currently known about the aquatic and piscivorus species in the Sheboygan River and Harbor aquatic ecosystem.

Examples of food web exposure pathways are shown in Figure 4, on page 25. Potential ecological receptor species considered for this risk assessment are benthic invertebrates (flies, beetles and clams), fish (sunfish, bass, carp, minnows, suckers, coho salmon, chinook salmon, and steelhead trout), birds (northern pintail, Northern shoveler, lesser scaup, gulls, terns, cormorants, ospreys, mallards, black ducks, Canada geese, swallows and wood ducks, kingfishers and great blue herons) and mammals (muskrat, raccoon, beaver and mink) that depend on aquatic resources of the Sheboygan River.

Contaminants considered potential chemicals of concern (COCs) included metals, PCBs, and PAHs. A contaminant is a COC if its maximum on-site concentration detected in the sediments of the Sheboygan River exceeded the sediment benchmark concentration. All potential COCs had maximum concentrations that exceeded their respective benchmarks and therefore were retained as COCs for benthic organisms. The metals included as COCs were arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc. Concentrations of PCBs and PAHs in the sediments exceeding the screening criteria were widespread and of high magnitude. Metal concentrations exceeded the benchmarks at fewer locations and at lower magnitude.

Metals, PCBs, and PAHs were also potential COCs for fish. Concentrations of metals detected in fish from the site area did not exceed the respective mean concentrations in reference area fish enough to warrant inclusion of any metals as COCs for fish. For mammals and birds, potential COCs were mercury, PCBs, and PAHs. PCBs were automatically included as COCs because of the elevated fish tissue and sediment concentrations at the study site.

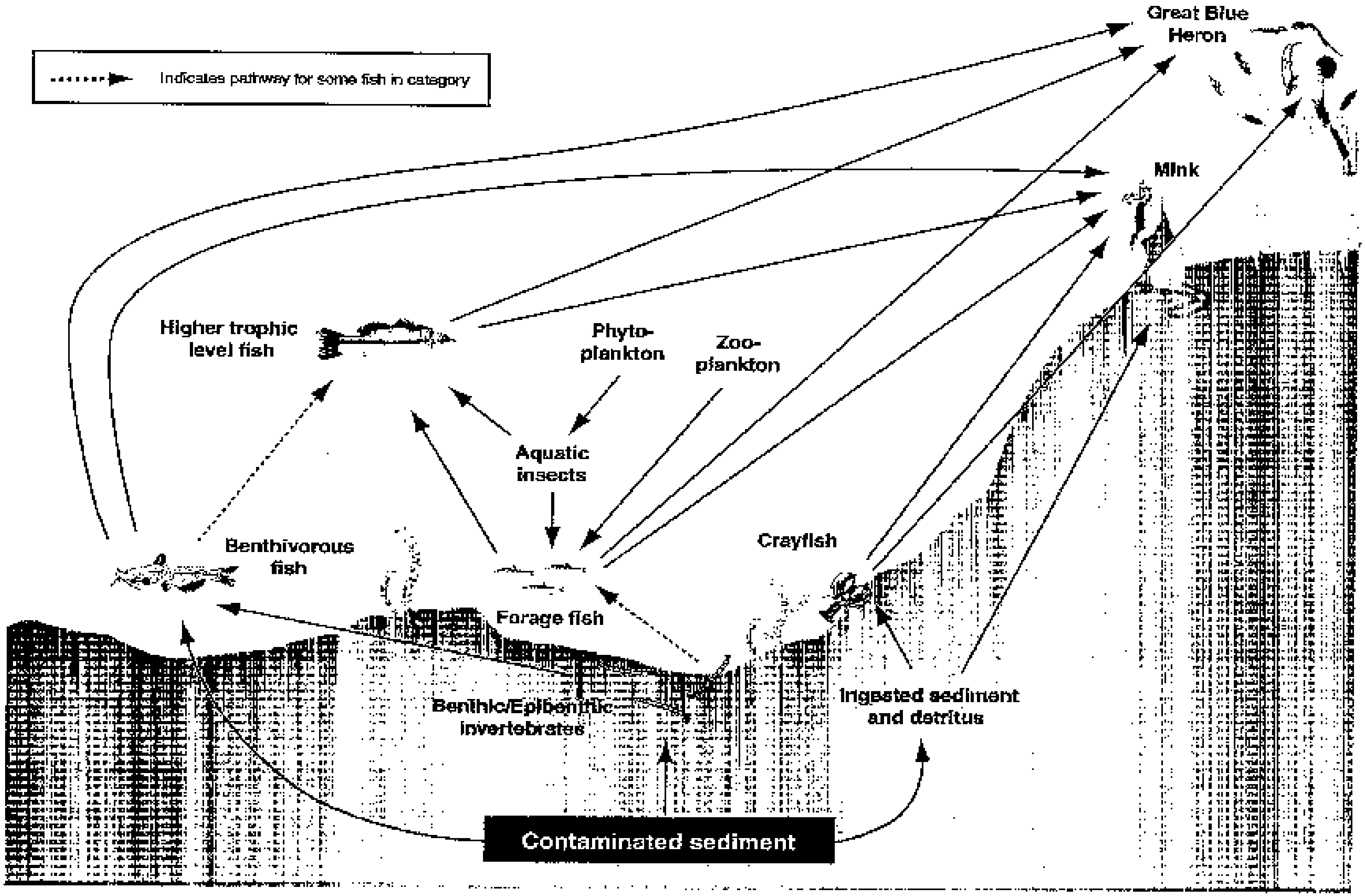

Figure 4. Sheboygan River and Harbor Aquatic food web exposure pathways

Table 9 shows the maximum concentrations of contaminants in river sediment compared to the threshold effects level.

Table 9 - Maximum Concentrations of Contaminants in River Sediment Compared to Threshold Effects Level (TEL)

		Maximum site concentration (ppm)				
Contaminant	TEL	River (BBL 1990)	Lower River & Harbor (BBL 1990)	Sediment Trap (WDNR 1997)	Sediment Core (WDNR 1997)	1997 NOAA Risk Assessment
Metals						
Arsenic	10.8	**23**	**20**	**25**	1.9	2.8
Cadmium	0.583	**3.2**	**3.7**	**1.2**	**2.2**	0.47
Chromium	36.3	**140**	**460**	35	28	**79**
Copper	28	**160**	**150**	**63**	**87**	**35**
Lead	37.2	**720**	**720**	**110**	**63**	**130**
Mercury	0.174	**0.42**	**0.68**	**0.79**	**0.27**	**0.20**
Nickel	19.5	**90**	**350**	**21**	N/A	19
Silver	- -	0.63	0.9	Na	6	0.25
Zinc	98.1	**300**	**370**	**170**	N/A	**110**
Organic Compounds						
Total PAHs	0.264	**4.0**	**63**	**44**	**26**	**7.2**
Total PCBs	0.0316	**4,500**	**0.22**	**180**	**460**	**760**

Table 10 summarizes the contaminants of concern evaluated after the screening process.

Table 10 - Contaminants of Concern selected for the NOAA Aquatic Risk Assessment Following Screening Procedures

Receptor of Concern	**PCBs**	**PAHs**	**Metals**
Benthic Invertebrates	%	%	%
Fish	%	%	
Birds	%		
Mammals	%		

The Sheboygan River and Harbor ecosystem includes a diverse range of species and functions, a subset of which was evaluated in the NOAA risk assessment. Since the risk assessment could not evaluate all species and all possible toxicological effects, important and representative species were selected as surrogates for the ecosystem and ecologically significant effects were emphasized. Based upon a review of the NOAA Aquatic Risk Assessment, PCB-contaminated sediment pose a risk to fish and wildlife. U.S. EPA has analyzed the ecological risk, in consultation with the natural resource trustees. A sediment cleanup goal between 0.05 ppm and 1.0 will protect fish and wildlife. The 0.05 ppm level represents the No Observed Adverse Effects Level (NOAEL) for the mink while the 1.0 ppm represents the Lowest Observed Adverse Effects Level (LOAEL) for the Heron. The Superfund program strives for clean up targets between the NOAEL and LOAEL, which is similar to the approach to the human health target range of 1×10^{-4} to 1×10^{-6} . Table 11 shows the NOAEL and LOAEL for fish, heron and mink.

Table 11 - Total PCB Protective Sediment Concentrations (ppm)

	Fish		Heron		Mink	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Range	3.7 - 16.0	6.0 - 25.0	0.1 - 0.7	0.2 - 1.0	0.05 - 0.7	0.7 - 1.5

<u>Terrestrial Assessment</u>

The floodplain terrestrial ecological risk assessment (TERA), part of the risk assessment efforts at the Sheboygan River and Harbor site, is a companion to the aquatic ecological risk assessment (AERA 1998). The terrestrial wildlife present along most of the upper Sheboygan River would be species adapted to mixed open, shrub, and wooded habitats that are tolerant of human disturbance. Species dependent on forested habitat may be present in the approximately 35-acre wooded "peninsula" formed by a clockwise loop of the river. This forested area is less disturbed by humans because it is surrounded by the river on three sides with no easily fordable approaches, and is backed by a steep slope on the fourth side.

Birds that include earthworms in their diets (vermivores) are of particular concern, since this is the probable pathway of greatest exposure to floodplain PCBs. Vermivorous robins and eastern bluebirds are present along the Sheboygan River in open and mixed habitats. Ovenbirds, another vermivorous species, nest in forested habitats. Ring-billed gulls also include worms in a highly varied diet, and forage far inland. Many species of birds feed on terrestrial invertebrates (beetles and other insects, spiders, etc.), such as brown thrashers, wrens, killdeer (especially beetles), young wood duck, blue jays, northern flickers (especially ants), common grackles (also steal food from robins), and spotted sandpipers (Bellrose 1976; Johnsgard 1981; Ehrlich, et al. 1988). These species could be exposed to soil PCBs through their prey (although probably not as much exposure as vermivores), but also may opportunistically include earthworms in their diets when readily available.

The TERA was based on PCB congener-specific analyses of co-located earthworm and soil samples collected November 2 - 3, 1997. The worm congener data were extrapolated to robin egg concentrations, which were compared with egg toxicity data on three bases: total PCBs, specific congeners, and dioxin toxic equivalents. The egg HQs, based on hatchability and malformations, ranged from 13 to 48 for no observed adverse effect concentrations (NOAEC), and from 6 to 22 for lowest observed adverse effect concentrations (LOAEC) for the central tendency scenarios of the various approaches. For the 95 percent upper confidence limit scenarios, NOAEC-HQs ranged from 22 to 80, and LOAEC-HQs ranged from 9 to 36. HQs were also developed on the basis of dose to adult birds, but the results varied by as much as an order-of-magnitude: central tendency 30 - 280 NOAEL-HQs and 3 - 120 LOAEL-HQs.

Since egg-based risk estimates were less variable than oral dose-based estimates, the egg bioaccumulation models were used to back-calculate ecologically protective earthworm concentrations separately for total PCBs and on a congener-specific basis. Ecologically-protective soil preliminary remedial goals (PRGs) were back-calculated from earthworms by use of site-specific soil-to-earthworm bioaccumulation factors (BAFs). Soil PRGs are 1 - 2 ppm total PCBs based on NOAECs, and 3 - 5 ppm based on LOAECs.

TERA Goals

There are two main goals of an ecological risk assessment (ERA): 1) to determine whether harmful effects are likely for wild animals or plants, and 2) if there is risk, to calculate a protective remedial goal that would reduce the risk to wild animals or plants. Only wildlife is considered, domesticated animals or plants are excluded from ERA. The process for performing an ERA is described in the Superfund guidance for ecological risk assessment (U.S. EPA 1997).

Chemicals of Concern

The TERA focused solely on PCBs because they were previously identified as a potential COC in floodplain soils. Chlorinated dioxins and dibenzofurans were not included because they were shown to make only a minor contribution (less than 10 percent) to the toxicity of fish contaminant loads in the Sheboygan River (AREA 1998). The PCBs in the upper river floodplain were deposited by floods, so the contaminant composition of the upper floodplain soils should be similar to that of the river sediments. Exclusion of dioxins and furans may result in a modest underestimation of floodplain contaminant risks.

Assessment Endpoint

The assessment endpoint for the TERA is reproductive performance in terrestrial vermivorous and insectivorous species (feeds on earthworms and insects, respectively). The endpoint selection was based on fate and transport of PCBs, bioaccumulation potential, and likely ecotoxicological effects.

Measurement Endpoint

The measurement endpoint is modeled reproductive performance in robins. Robins feed predominantly on insects, earthworms and other invertebrates during the breeding and nesting season, and therefore should be representative of a variety of birds that have similar diets. Woodcock would be expected to show greater risk than robins since they feed almost exclusively on earthworms (earthworms accumulate higher levels of PCBs from soil than do most insects). However, U.S. EPA and WDNR biologists agreed that the habitats along the floodplain sections with elevated soil PCBs are not favorable for woodcock or snipe. Robins were selected as reasonably representative of potential avian receptors in the floodplain section under consideration.

Although mammals were not considered in this risk assessment, mammals that feed on worms for much (shrews, moles) or part (raccoons, skunks, opossum) of their diets may also be at risk (Whitaker and Hamilton 1998). Surprisingly, even fox may eat substantial numbers of worms when available (MacDonald 1980). The vermivorous northern short-tailed shrew and star-nosed mole are likely present at Sheboygan along with the remaining aforementioned mammals.

The PCB dose to robins feeding in the contaminated floodplain was calculated for consumption of three broad categories of prey: earthworms, hard-bodied invertebrates (beetles), and soft-bodied invertebrates (other than earthworms) (Figure 5). Several, other potential exposure pathways were not included in the model.

Hard-bodied Invertebrates (14%) Robin Ingestion (adult oral dose)
ü ú ü
Floodplain Soil PCBs û Earthworms (24%) û Robin Diet
ú ü ú
Soft-bodied Invertebrates (49%) Robin Egg

Measured values: soil and earthworm PCB concentrations (congener-specific and total).
Modeled values: hard- and soft-bodied invertebrate, robin diet, and egg concentrations; and oral dose.
Contribution to robin diet in parentheses.

Figure 5- Robin PCB Exposure Model, Sheboygan River Floodplain, WI

Risk Summary

The results of the modeling and risk characterization approaches utilized in the TERA consistently indicated increased risks of adverse reproductive effects in robins foraging in contaminated sections of the Sheboygan River floodplain. Risk estimates for egg concentrations were less variable than for oral doses to adult robins. Egg NOAEC- and LOAEC-based HQs ranged from 10 to 50, and from 6 to 20, respectively, for central tendency exposure scenarios. HQs ranged as high as 40 and 80, based on NOAEC and LOAEC, respectively, for the 95 percent upper confidence limit (95 percent UCL) exposure scenarios. In contrast, adverse effects are unlikely in the reference location where the egg HQs were two orders of magnitude less than the level of concern.

Ecologically Protective Soil Preliminary Remedial Goals (PRGs)

Egg-based risk estimates were much less variable than oral dose-based estimates, so the egg model was used to back-calculate soil ecologically protective remedial goals (PRGs). PRGs were calculated on the basis of total PCBs, and two congener-specific models that differed in the biomagnification factors used to estimate egg congener concentration from the robin dietary concentration. We did not use dioxin toxic equivalents to back-calculate soil PRGs because congener-specific risk estimates were available for the congeners that predominantly contribute to the dioxin toxic equivalents. The risk estimates based on direct assessment of congener-specific toxicity were considered more reliable than risk estimates based on indirect assessment of the relative toxicities of PCB congeners compared to dioxin. PRGs are shown in Table 12.

TERA Risk Summary

The total PCB-based and congener-specific-based PRGs indicate that adverse effects are unlikely where soil PCB concentrations are at or below 1 - 2 ppm. The congener-specific LOAEC-based soil PRGs range from 3 to 5 ppm, depending on the biomagnification model, but the results bracket the total PCB LOAEC-based PRG of 4 ppm. This indicates that adverse effects may occur where soil PCB concentrations exceed 3 - 5 ppm.

TERA Risk Summary Adjusted for Soil PRGs

The soil PRGs were adjusted for foraging area use based on the floodplain delineation sampling Tecumseh performed in 1992 (post-phases I and II) (ASRI 1995). Two extrapolations were performed: one for the robin foraging range during the time they are feeding nestlings, and the second for the foraging range during the time they are caring for fledglings. The NOAEC-based PRG did not change, but the LOAEC-based PRG increased to 9 ppm for the fledgling stage. Therefore, robins with fledgling stage foraging areas bordering the Sheboygan River are at risk of reproductive impairment where the floodplain soil mean PCB concentration exceeds 9 ppm.

Surface Weighted Average Concentration performed on a scale appropriate for robin foraging areas indicated that remediation of floodplain soil equal to or greater than 10 ppm PCB should be protective, that is, it should result in foraging SWAC at or below 5 ppm, with few exceptions. Remediation of floodplain soil PCB concentrations equal to or greater than 50 ppm may be appropriate in select areas of high quality forested habitat on the basis of a risk management decision to balance risk reduction with habitat preservation, but it is not justifiable on the basis of SWAC when averaged over a scale appropriate for foraging robins.

Table 12 - Ecologically Protective Soil Preliminary Remedial Goals (PRGs), Sheboygan River Floodplain, WI.

Toxicity Basis	NOAEC-based PRG	LOAEC-based PRG
	(ppm total PCBs)	
Total PCBs [a]	1	4
Congener-specific [b]	1.5	3
Congener-specific [c]	2	5
Area Use Adjusted [d]	no change	4 - 9

a) Modeled with gull diet-to-egg BMF (Braune and Norstrom 1989).
b) Modeled with tern BMF (Kubiak, et al. 1989).
c) Modeled with gull BMF (Norstrom pers. comm. in Hoffman, et al. 1996).
d) Combined results for nestling-stage and fledgling-stage foraging areas, respectively.

BMF - Bio-magnification Factor

Risk Summary

Table 13 summarizes the PCB target concentrations for human health and ecological risks.

Table 13 - Sheboygan River & Harbor PCB Target Sediment & Soil SWAC Concentration Ranges (ppm)

Human Health (10^{-6} to 10^{-4})	Ecological Health (NOAEL to LOAEL)	
Sediments	Sediments	Floodplain Soil
0.005 - 0.5	0.05 to 1.0	0.05 to 10

H. REMEDIATION OBJECTIVES

There are three primary remediation objectives.

1. Protect human health and the environment from imminent and substantial endangerment due to PCBs attributed to the Site.

To achieve this remediation objective, PCB-contaminated soft sediment will be removed so that the entire river will reach an average PCB sediment concentration of 0.5 ppm or less over time. An average PCB sediment concentration of 0.5 ppm results in an excess human health carcinogenic risk of 1.0×10^{-4}, or less over time, through the consumption of PCB-contaminated fish.

Based on site specific biota to sediment accumulation factors, the corresponding PCB tissue levels for resident fish are:

Sport Fish
Small Mouth Bass: 0.31 ppm, Walleye: 0.63, Trout: 0.09 ppm

Bottom Feeders
Carp: 2.58 ppm, Catfish: 2.53 ppm

Achievement of the soft sediment concentration and fish tissue concentrations, over time, will be reevaluated every five years after completion of the remedy.

Reaching the river sediment objective of a 0.5 ppm average PCB concentration requires different approaches for the Upper, Middle, and Lower River, and the Inner Harbor because of the way sediment is distributed and whether the contaminated sediment is considered mobile given the dynamics of that specific river component.

For PCB-contaminated floodplain areas, this remediation objective will be achieved by removing sufficient contaminated soil to reach an average PCB soil concentration of 10 ppm or less. The areas of soil remediation will be backfilled to its previous grade and re-vegetated to prevent future soil erosion and siltation in the river. With respect to PCB-contaminated ground-water or other potential sources near Tecumseh's Sheboygan Falls plant, the remediation objective will be to investigate and stop all additional PCB sources to the river system.

2. Mitigate potential PCB sources to the Sheboygan River/Harbor system and reduce PCB transport within the river system.

As mentioned previously, additional investigations will occur to determine the effects of PCB-contaminated ground-water or possible additional PCB, sources from Tecumseh's Sheboygan Falls plant. In addition, because of the dynamic nature of the Upper River and Middle River segments of the Sheboygan River, PCB-contaminated soft sediment deposits will be removed to achieve an average soft sediment deposit SWAC of 0.5 ppm. This includes PCB mass removal of 88% in the Upper River. Lastly, PCB-contaminated floodplain soil may act as a future source to the river during high flow events, therefore, PCB contaminated soil will be removed in seven areas. Since some of the areas within these floodplain soils may be considered high-quality habitat, the removal of PCB-contaminated soil will be balanced with keeping high-quality habitat intact to the extent practicable.

3. Remove and dispose of Confined Treatment Facility (CTF) / Sediment Management Facility (SMF) sediments and previously armored/capped PCB-contaminated soft sediment deposits.

The CTF and SMF were not designed to be permanent structures. As part of the remediation of the site, sediments in the CTF and SMF will be disposed of in a WDNR approved off-site landfill. In doing so, this action will reduce the long-term management and maintenance requirements for the site. In addition, because recent information collected by Tecumseh indicates that there may be continuing discharges of PCBs from Area 1 and because of concerns about the effectiveness of all of the previously armored/capped soft sediment deposits, the armored/capped sediment deposits, including Area 1, will be removed.

I. DESCRIPTION OF ALTERNATIVES

Based on RI/FS reports and previous investigations, U.S. EPA evaluated several alternatives to address contamination in and near the Sheboygan River and Harbor. Because the level of contamination varies in different parts of the river, the proposed cleanup plan has five components: 1) upper river sediment; 2) middle river sediment; 3) lower river and harbor sediment; 4) floodplain soil adjacent to the river; and 5) ground water near Tecumseh's Sheboygan Falls plant. A long-term monitoring plan which includes 30 years of fish sampling will be implemented for the entire river and harbor.

In evaluating the alternatives, U.S. EPA considered the level of protection that would satisfy the concern of the natural resource trustees that future natural resource injuries be minimized. The natural resource trustees have concluded that, given the proposed cleanup level of 0.5 ppm PCBs in soft sediment and 10 ppm PCBs in floodplain soil, the natural resources will continue to incur injuries. These additional injuries will be factored into the resolution of the natural resource liability. U.S. EPA also considered the extent to which implementing the alternatives could bring about additional adverse impacts to natural resources.

UPPER RIVER SEDIMENT

Forty-six separate deposits of PCB-contaminated soft sediment have been identified in the Upper River. Because of recent flooding on the Sheboygan River, the location and size of some of these deposits may have changed since the deposits were originally identified. U.S. EPA's goal is to reduce imminent and substantial threats to human health and the environment by removing PCB-contaminated sediment in these soft sediment deposits. Three alternatives were developed to address Upper River sediment. However, there are six sub-alternatives, with varying amounts of sediment removal, under the Alternative #3. Each remedy alternative shows the capital and operation and maintenance (O&M) costs.

<u>Alternative 1: No Action</u>

Estimated Capital Cost: $0 million
Annual O & M Cost: $0
Total Present Value (7% discount rate): $0 million.
Estimated Time to Implement: 0 months

The NCP requires the no-action alternative. Its purpose is to allow comparison of alternatives to the conditions that currently exist and that will likely exist in the future. Under this alternative, no further action would be taken in the Upper River beyond dredging and armoring already completed. Fish and waterfowl consumption advisories would remain in place until monitoring indicates they can be dropped.

<u>Alternative 2: Natural Recovery/Monitoring and Disposal of CTF & SMF Sediments</u>

Estimated Capital Cost: $2.6 million
Annual O & M Cost: $ 140,000 or 147,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $4.5 million.
Estimated Time to Implement: 2 Months

Under this alternative, sediment monitoring would be done every 5 years and annual fish monitoring would take place for 30 years. Periodic maintenance of already-capped areas would also continue for 30 years. Contaminated sediment stored at the Tecumseh plant would be disposed of in a WDNR-approved landfill.

<u>Alternative 3: Sediment Removal</u>

Six Upper River sediment removal sub-alternatives have been developed. The sub-alternatives vary in terms of the amount of sediment and PCBs that would be removed and build upon each other. For example, sediments removed under Alternative 3-II include sediments removed under Alternative 3-I. Sediments removed under Alternative 3-III include sediments removed under Alternative 3-II which include sediments under Alternative 3-I. The cumulative PCB percentages described in the FS include PCBs removed as part of the 1991 removal action. The use of these figures may cause people to assume that more contaminated sediment is being removed then would actually occur under the remedial action, PCB percentages in the following six alternatives represent the percentage of the remaining PCBs in the Upper River after dredging with 90 percent efficiency.

Future removal activities will likely use mechanical dredging to excavate the contaminated sediment, however, the actual removal technology used will be determined during the design phase of the site. The contaminated sediment will be dewatered, stabilized and placed in either a solid waste landfill or licensed hazardous waste landfill depending on the level of PCB concentration. Contaminated sediment stored at the Tecumseh plant would be disposed of in a licensed hazardous waste landfill due to its high level of contamination.

Alternative 3-I

Estimated Capital Cost: $10.7 million
Annual O & M Cost: $ 140,000 or 175,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $11.1 million.
Estimated Time to Implement: 16 months

Removal of approximately 5,400 cubic yards of sediment containing 34 percent of the Upper River's PCBs. U.S. EPA estimates that removal of 34 percent of the remaining PCBs in the Upper River will be necessary to achieve a PCB soft sediment deposit SWAC of 2.9 ppm for the Upper River. Under this alternative, the areas capped/armored during ASRI/removal action activities would be removed. Removal of sediment under this alternative would require obtaining access at two points along the Upper River. Annual fish sampling will occur until fish consumption advisories are lifted. Sediment samples will be taken at least once every five years, after dredging is complete, to document natural processes.

Alternative 3-II

Estimated Capital Cost: $14.2 million
Annual O & M Cost: $ 140,000 or 175,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $13.8 million.
Estimated Time to Implement: 21 months

Removal of approximately 7,500 cubic yards of sediment containing 62 percent of the Upper River's PCBs. U.S. EPA estimates that removal of 62 percent of the remaining PCBs in the Upper River will be necessary to achieve a PCB soft sediment deposit SWAC of 2.8 ppm for the Upper River. Under this alternative, the areas capped/armored during

ASRI/removal action activities would be removed. Removal of sediment under this alternative requires four access points along the Upper River. Annual fish sampling will occur until fish consumption advisories are lifted. Sediment samples will be taken at least once every five years, after dredging is complete, to document natural processes.

Alternative 3-III

Estimated Capital Cost: $16.1 million
Annual O & M Cost: $ 140,000 or 175,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $15.2 million.
Estimated Time to Implement: 26 months

Removal of approximately 8,900 cubic yards of sediment containing 72 percent of the Upper River's PCBs. U.S. EPA estimates that removal of 72 percent of the remaining PCBs in the Upper River will be necessary to achieve a PCB soft sediment deposit SWAC of 2.6 ppm for the Upper River. Under this alternative, the areas capped/armored during ASRI/removal action activities would be removed. Removal of sediment under this alternative requires five access points along the Upper River. Annual fish sampling will occur until fish consumption advisories are lifted. Sediment samples will be taken at least once every five years, after dredging is complete, to document natural processes.

Alternative 3-IV

Estimated Capital Cost: $22.2 million
Annual O & M Cost: $ 140,000 or 175,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $19.1 million.
Estimated Time to Implement: 42 months

Removal of approximately 13,800 cubic yards of sediment containing 78 percent of the Upper River's PCBs. U.S. EPA estimates that removal of 78 percent of the remaining PCBs in the Upper River will be necessary to achieve a PCB soft sediment deposit SWAC of 2.0 ppm for the Upper River. Under this alternative, the areas capped/armored during ASRI/removal action activities would be removed. Removal of sediment under this alternative requires six access points along the Upper River. Annual fish sampling will occur until fish consumption advisories are lifted. Sediment samples will be taken at least once every five years, after dredging is complete, to document natural processes.

Alternative 3-IV-A

This alternative, developed by U.S. EPA, represents a variation of the removal alternatives presented in the FS.

Estimated Capital Cost: $30.6 million
Annual O & M Cost: $140,000 or $175,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $23.8 million.
Estimated Time to Implement: 60 months

Removal of approximately 20,774 cubic yards of sediment containing 88 percent of the Upper River's PCBs. U.S. EPA estimates that removal of 88 percent of the remaining PCBs in the Upper River will be necessary to achieve a PCB soft sediment deposit SWAC of 0.5 ppm for the Upper River. Under this alternative, the areas capped/armored during ASRI/removal action activities would be removed. Area 1, which was capped/armored during ASRI/removal action activities, will be removed. The FS assumes that this deposit will remain in place, however, recent information collected by Tecumseh indicates that there may be continuing discharges of PCBs from this area. Removal of sediment under this alternative requires five access points along the Upper River. Annual fish sampling will occur until fish consumption advisories are lifted. Sediment samples will be taken at least once every five years, after dredging is complete, to document natural processes and to ensure that over time the entire river will reach an average PCB sediment concentration of 0.5 ppm, or less, and that over time fish consumption advisories can be phased out.

Alternative 3-V

Estimated Capital Cost: $33.6 million
Annual O & M Cost: $140,000 or 175,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $25.6 million.
Estimated Time to Implement: 65 months

Removal of approximately 22,500 cubic yards of sediment containing 90 percent of the Upper River's PCBs. U.S. EPA estimates that removal of 90 percent of the remaining PCBs in the Upper River is expected to achieve a PCB soft sediment deposit SWAC of 0.4 ppm for the Upper River. Under this alternative, the areas capped/armored during ASRI/removal action activities would be removed. Removal of sediment under this alternative requires six access points along the Upper River. Annual fish sampling will occur until fish consumption advisories are lifted. Sediment samples will be taken at least once every five years, after dredging is complete, to ensure that over time the entire river will reach an average PCB sediment concentration of 0.4 ppm, or less, and that over time fish consumption advisories can be phased out.

Middle River Sediment

Surface sediments in the Middle River generally contain relatively low levels of PCBs and some heavy metals. Using the 1987 RI data, the overall soft sediment SWAC for the Middle River is currently 1.5 ppm but sediment PCB levels have been found at levels as high as 37 ppm. Three alternatives were developed for the Middle River.

<u>Alternative 1: No Action</u>

Estimated Capital Cost: $0
Annual O & M Cost: $0
Estimated Time to Implement: 0 years

This alternative is similar to the no-action alternative for the Upper River; nothing would be done in the Middle River under this alternative. Fish and waterfowl consumption advisories would remain in place until monitoring indicates they can be dropped.

<u>Alternative 2: Characterization and Monitored Natural Processes</u>

Estimated Capital Cost: $0
Annual O & M Cost: $140,000 or 175,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $2.0 million.
Estimated Time to Implement: 0 months

Due to the presence of PCB contamination and the dynamic nature of the river, this component of the river will be re-characterized to establish an accurate picture of contaminant distribution in soft sediment and to determine if removal of PCB-contaminated soft sediment is warranted. In addition, re-characterization will become the baseline for evaluating natural processes trends and tracking soft sediment concentrations toward a soft sediment SWAC of 0.5 ppm for the Middle River over time. A monitoring program would be implemented to gauge the condition of the river and potential human health impacts over time. Long-term monitoring will provide valuable information on changing conditions that may warrant removal of PCB-contaminated sediment. Annual fish sampling will be required until fish consumption advisories are lifted. Sediment samples will be required at least once every five years to document natural processes and ensure that, over time, the Middle River will reach an average PCB sediment concentration of 0.5 ppm, or less. ***This alternative was not considered in the FS and was developed by the U.S. EPA.***

Alternative 3: Characterization, Sediment Removal and Monitored Natural Processes

Estimated Capital Cost: $18. 1 million
Annual O & M Cost: $140,000 or 175,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $13.1 million
Estimated Time to Implement: 49 months

Due to the presence of PCB contamination and the dynamic nature of the river, this component of the river will be re-characterized to determine what soft sediment deposits will be removed to achieve a soft sediment SWAC of 0.5 ppm for the Middle River upon completion of the remedial action. Using the 1987 RI data, the overall soft sediment SWAC for the Middle River is currently 1.5 ppm. Based on this information 13,684 cubic yards of PCB-contaminated sediment would be removed to achieve a soft sediment SWAC of 0.5 ppm for the Middle River.

A monitoring program would be implemented to gauge the condition of the river and potential human health impacts over time. Long-term monitoring will provide valuable information on changing conditions that may warrant removal of PCB-contaminated sediment. Annual fish sampling will occur until fish consumption advisories are lifted. Sediment samples will be taken at least once every five years to document natural processes and ensure that over time the Middle River will remain at an average PCB sediment concentration of 0.5 ppm, or less. ***This alternative was not considered in the FS and was developed by the U.S. EPA.***

Lower River and Inner Harbor Sediment

Seven alternatives were developed for the Lower River and Inner Harbor. Alternatives 3, 4 and 6 were developed by U.S. EPA and are not included in the FS. All alternatives include maintaining the existing north and south outer harbor breakwalls. The outer harbor breakwalls protect Inner Harbor sediment from Lake Michigan wave action and keep the highest levels of contaminated PCB sediment at depth.

Alternative 1: No Action

Estimated Capital Cost: $0
Annual O & M Cost: $0
Estimated Time to Implement: 0 years

In this alternative nothing would be done in the Lower River and Inner Harbor. Fish and waterfowl consumption advisories would remain in place until monitoring indicates that they can be dropped.

Alternative 2: Monitored Natural Processes

Estimated Capital Cost: $0
Annual O & M Cost: $ 201,300 or 326,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $3.1 Million
Estimated Time to Implement: 0 months

Annual fish and sediment monitoring will occur until fish and waterfowl advisories are lifted. Fish and waterfowl consumption advisories will remain in place until monitoring indicates that they can be dropped. The outer harbor breakwalls will be maintained to keep contaminated sediments at depth.

Alternative 3: Inner Harbor Sediment Trap

Estimated Capital Cost: $10.4 million
Annual O & M Cost: $ 201,300 or 237,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $9.3 Million
Estimated Time to Implement: 4 months

Approximately 27,000 cubic yards of contaminated sediment will be excavated to create a sediment trap. The sediment trap will be installed to capture contaminated sediment and keep it from entering Lake Michigan. The dredged sediment will be dewatered, stabilized, and disposed of in either a WDNR-approved in-state landfill or out-of-state hazardous waste landfill depending on its PCB concentration. Any areas of Lower River and Inner Harbor that are excavated will be backfilled with clean sediment in a manner to minimize resuspension or disturbance of contaminated sediments. Annual fish sampling will occur until fish consumption advisories are lifted. Sediment samples will be taken at least once every year to document natural processes and ensure that over time the Lower River and Inner Harbor reach an average PCB sediment concentration of 0.5 ppm, or less. Fish and waterfowl consumption advisories will remain in place until monitoring indicates that they can be dropped. The outer harbor breakwalls will be maintained to keep contaminated sediments at depth. ***This alternative was not considered in the FS and was developed by the U.S. EPA.***

Alternative 4: Lower River and Inner Harbor Sediment Removal Subject to Natural and Recreational Disturbances

Estimated Capital Cost: $12.1 million
Annual O & M Cost: $201,300 or 237,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $10.0 Million
Estimated Time to Implement: 2 years

Under this Alternative, U.S. EPA estimates that 53,000 cubic yards of contaminated sediment, in the Inner Harbor, will be dredged so that the Lower River and Inner Harbor surface sediments will achieve a PCB concentration of 0.5 ppm, or less, on average over time. Prior to any dredging, characterization of the Inner Harbor is necessary to delineate PCB concentrations at depth. Any dredged sediment would be dewatered, stabilized, and disposed of in either a WDNR-approved in-state landfill or out-of-state hazardous waste landfill depending on its concentration. Annual bathymetric surveys will be required to assess sediment profile changes and determine if buried PCB-contaminated sediment is vulnerable to disturbance and release.

Like the inner Harbor, portions of the Lower River may contain contaminated sediment that will impair surface sediments from achieving a 0.5 ppm average over time. Characterization of the sediment will be conducted to determine if any of these contaminated sediment areas currently exist. Contaminated sediment with concentrations greater than 26 ppm within the top 2 feet will be removed. Similar to the Inner Harbor, annual bathymetric surveys will be required to assess sediment profile changes and determine if buried contaminated sediment is vulnerable to release. Any areas of Lower River and Inner Harbor that are excavated will be backfilled with clean sediment in a manner to minimize resuspension or disturbance of remaining contaminated sediments.

Annual fish samples will taken until fish consumption advisories are lifted. Sediment samples will be taken at least once every five years to document natural processes and ensure that over time the Lower River and Inner Harbor reach an average PCB sediment concentration of 0.5 ppm, or less. Fish and waterfowl consumption advisories will remain in place until monitoring indicates they can be dropped. The outer harbor breakwalls will be maintained to keep contaminated sediments at depth. ***This alternative was not considered in the FS and was developed by the U.S. EPA.***

Alternative 5: Inner Harbor Sediment Capping

Estimated Capital Cost: $12.9 million
Annual O & M Cost: $ 187,300 or 312,300 or 487,300
Duration of O & M: 30 years
Total Present Value (7% discount rate): $10.8 Million
Estimated Time to Implement: 1 year

The Inner Harbor will be covered with a geotextile fabric, 20 inches of course-grained stone, and 12 inches of 6- to 8-inch diameter stone. Annual fish sampling will occur until fish consumption advisories are lifted. Sediment samples will be taken at least once every five years to document natural processes and ensure that over time the Lower River and Inner Harbor reach an average PCB sediment concentration of 0.5 ppm, or less. The outer harbor breakwalls will be maintained to keep contaminated sediments at depth.

Alternative 6: Inner Harbor Surface Sediment Removal

> *Estimated Capital Cost: $21.6 million*
> *Annual O & M Cost: $201,300 or $237,000*
> *Duration of O & M: 30 years*
> *Total Present Value (7% discount rate): $14.6 Million*
> *Estimated Time to Implement: 4 years*

Under this alternative, the top 2 feet, approximately 117,000 cubic yards, of contaminated sediment will be dredged from the harbor and replaced with clean sediment. The dredged sediment will be dewatered, stabilized, and disposed of in a WDNR-approved in-state landfill. Any areas of Lower River and Inner Harbor that are excavated will be backfilled with clean sediment in a manner to minimize resuspension or disturbance of remaining contaminated sediments.

Annual fish samples will be taken until fish consumption advisories are lifted. Sediment samples will be taken at least once every five years to document natural processes and ensure that over time the Lower River and Inner Harbor reach an average PCB sediment concentration of 0.5 ppm, or less. Fish and waterfowl consumption advisories will remain in place until monitoring indicates they can be dropped. The outer harbor breakwalls will be maintained to keep contaminated sediments at depth. ***This alternative was not considered in the FS and was developed by the U.S. EPA.***

Alternative 7: Inner Harbor Sediment Removal - Complete Excavation

> *Estimated Capital Cost: $339.2 million*
> *Annual O & M Cost: $75,000 or $187,300*
> *Duration of O & M: 30 years*
> *Total Present Value (7% discount rate): $169.3 Million*
> *Estimated Time to Implement: 6 years*

This alternative includes the removal of approximately 960,000 cubic yards of sediment between the Pennsylvania Avenue bridge and the mouth of the Inner Harbor. The dredged sediment will be dewatered, stabilized, and disposed of in either a WDNR-approved in-state landfill or out-of-state hazardous waste landfill. Annual fish samples will be taken until fish consumption advisories are lifted. Sediment samples will be taken at least once every five years to document natural processes and ensure that over time the Lower River and Inner Harbor reach an average PCB sediment concentration of 0.5 ppm, or less. Outer harbor breakwall maintenance will continue until all the Inner Harbor sediment is removed. Fish and waterfowl consumption advisories would remain in place until monitoring indicates they can be dropped.

Floodplain Soil

There are four alternatives for cleaning up contaminated floodplain adjacent to the river:

Alternative 1: No Action

Under this alternative, nothing will be done and floodplain soil will remain in its current state.

Estimated Capital Cost: $0
Annual O & M Cost: $0
Estimated Time to Implement: 0 months

Alternative 2: Bank Soil Stabilization

The upper 12 inches of soil will be removed from the river bank (from the waterline to where mature vegetation starts). Areas susceptible to erosion will be rehabilitated to prevent erosion.

Estimated Capital Cost: $644,000
Annual O & M Cost: $6,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $632,000
Estimated Time to Implement: 12 months

Alternative 3: Removal of Soil Containing More than 50 ppm of PCBs

Floodplain soil containing PCB concentrations greater than 50 ppm will be removed and disposed of off site at a licensed hazardous waste landfill. Areas of excavation will be re-vegetated.

Estimated Capital Cost: $1.9 million
Annual O & M Cost: $15,600
Duration of O & M: 30 years
Total Present Value (7% discount rate): $1.8 Million
Estimated Time to Implement: 12 months

Alternative 4: Removal of Soil Containing More than 10 ppm of PCB

Floodplain soil containing PCB concentrations greater than 10 ppm will be removed and disposed of off site at a licensed hazardous waste landfill. However, in some areas, contaminated soil with more than 10 ppm may be left in place to prevent negative impacts to high-quality habitat. Areas of excavation will be re-vegetated.

Estimated Capital Cost: $4.7 million
Annual O & M Cost: $29,800
Duration of O & M: 30 years
Total Present Value (7% discount rate): $4.5 Million
Estimated Time to Implement: 30 months

Ground -Water and Additional PCB Sources

Ground-water at Tecumseh's Sheboygan Falls plant contains elevated levels of PCBs. The four alternatives for addressing PCB-contaminated ground water are:

Alternative 1: No Action

Under this alternative, no action will be taken.

Estimated Cost: $0
Annual O & M Cost: $0
Estimated Time to Implement: 0 Years

Alternative 2: Investigation/Source Identification and Control

Estimated Capital Cost: $313,000
Annual O & M Cost: $21,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $594,000
Estimated Time to Implement: 12 months

Ground-water investigations will be required to determine the extent of the PCB contamination and the potential sources of the contamination. Following this investigation, a decision will be made regarding potential cleanup options including the potential for relying on natural attenuation. However, if natural attenuation is inappropriate to clean up ground-water, Alternative 3 will be selected.

Alternative 3: Collection Trench and Treatment

Estimated Capital Cost: $ 1.0 million
Annual O & M Cost: $37,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $1.5 Million
Estimated Time to Implement: 12 months

This alternative includes collecting ground-water in a ground-water collection trench, pumping out the water and treating it in the existing water treatment facility at the plant. Approximately eight additional ground-water monitoring wells will be installed. This alternative also requires an investigation of hydrogeologic conditions at the plant.

Alternative 4: Facility Perimeter Cut-off Wall

Under this alternative, a wall will be built in the ground around the plant to isolate the contaminated ground water. Five wells will be installed to pump the water to the surface for treatment. This alternative also requires an investigation of hydrogeologic conditions at the plant.

Estimated Capital Cost: $3.1 million
Annual O & M Cost: $37,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $3.6 Million
Estimated Time to Implement: 24 months

J. COMPARATIVE ANALYSIS OF ALTERNATIVES

The nine criteria used by U.S. EPA to evaluate remedial alternatives, as set forth in the NCP, 40 C.F.R. Part 300.430, include: 1) overall protection of human health and the environment; 2) compliance with applicable or relevant and appropriate requirements (ARARs); 3) long-term effectiveness and permanence; 4) reduction of toxicity, mobility, or volume through treatment; 5) short-term effectiveness; 6) implementability; 7) cost; 8) state acceptance; and 9) community acceptance.

The first two evaluation criteria are threshold criteria that all alternatives must meet. Criteria 3 through 7 are balancing criteria that are used to compare the alternatives against each other and determine which alternative provides the best balance of the evaluation criteria. The remaining two criteria are modifying criteria. The input from the community and the support agency are considered by the lead agency in making its final decision.

Threshold Criteria

1. **Overall Protection of Human Health and the Environment** addresses whether a remedy provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced or controlled through treatment, engineering, or institutional controls. The selected remedy must meet these criteria.

2. **Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)** addresses whether a remedy will meet applicable or relevant and appropriate federal and state environmental laws and/or justifies a waiver from such requirements. The selected remedy must meet this criteria or a waiver of the ARAR must be attained.

Primary Balancing Criteria

3. **Long-Term Effectiveness and Permanence** refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met.

4. **Reduction of Toxicity, Mobility, or Volume Through Treatment** addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances as their principal element. This preference is satisfied when treatment is used to reduce the principal threats at the site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media.

5. **Short-Term Effectiveness** addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed, until cleanup levels are achieved.

6. **Implementability** is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

7. **Cost** includes estimated capital costs, annual operation and maintenance costs (assuming a 30-year time period), and net present value of capital and operation and maintenance costs.

Modifying Criteria

8. **State Acceptance** considers whether the state agrees with U.S. EPA's analyses and recommendations of the RI/FS and the Proposed Plan, and considers state ARARs.

9. **Community Acceptance** addresses the public's general response to the remedial alternatives and proposed plan. The ROD will include a responsiveness summary that presents public comments and U.S. EPA responses to those comments. Acceptance of the recommended alternative will be evaluated after the public comment period.

Consistent with the rest of this document, the comparative analysis of the nine criteria will be organized by river component and presented in a tabular format.

Upper River Sediment Comparative Analysis								
Nine Criteria	Alt. 1 No Action	Alt. 2 Natural Recovery and Monitoring	Alt. 3-I Removal of 34% of PCBs	Alt. 3-II Removal of 62% of PCBs	Alt. 3-III Removal of 72% of PCBs	Alt. 3-IV Removal of 78% of PCBs	Alt. 3-IV-A Removal of 88% of PCBs	Alt. 3-V Removal of 90% of PCBs
Overall Protection of Human Health and the Environment	No risk reduction.	Allows continued contamination to remain in place. Risk reduction would be achieved through natural processes assuming no continuing sources to the river.	All of these removal alternatives vary to the degree to which they protect against the direct contact threat of contaminated sediments or achieve an average sediment concentration required to meet appropriate human and aquatic receptor levels. Alternative 3-V results in a soft sediment SWAC of 0.4 ppm which equates to a human health risk of 8.1 x 10-5 and falls within the LOAEL to NOAEL range for all aquatic receptors. Alternative 3-IV-A meets the US EPA soft sediment concentration SWAC target of 0.5 ppm which equates to a human health risk of 10 x 10-4 and falls within the LOAEL to NOAEL range for all aquatic receptors. Alternatives 3-I through 3-IV do not meet the threshold criteria for protection of human health and the environment and equate to risks greater than 1.0 x 10-4 for the soft sediment deposits. All risks are based on the RME bass consumption scenario.					
Compliance with Applicable or Relevant & Appropriate Requirements (ARARs)	These two alternatives do not involve any further in-river remediation. It is expected that chemical- and location-specific ARARs would be met. Also, since either minimal or no further activity would be taken at the site, it is expected that action-specific ARARs would not be involved. Removal of CTF and SMF sediments is expected to comply with all site ARARs since removed materials would be properly handled and disposed.		It is expected that alternatives I through V could meet all chemical-, location-, and action-specific ARARs for the site over time. However, all of these alternatives hold the possibility for short-term exceedances of Wisconsin surface water quality standards. In addition, since the WDNR has identified the Sheboygan River area as a possible habitat for some endangered species, it is possible that disruption or destruction of their habitat may occur through implementation of any of the six removal alternatives. Such disruptions would be successively greater for each removal alternative. However, reasonable precautionary measures would be undertaken to meet all chemical-, location-, and action -specific ARARs during implementation.					

Nine Criteria	Alt. 1 No Action	Alt. 2 Natural Recovery and Monitoring	Alt. 3-I Removal of 34% of PCBs	Alt. 3-II Removal of 62% of PCBs	Alt. 3-III Removal of 72% of PCBs	Alt. 3-IV Removal of 78% of PCBs	Alt. 3-IV-A Removal of 88% of PCBs	Alt. 3-V Removal of 90% of PCBs
Long-term Effectiveness and Permanence	Source has not been addressed. Existing risks will remain.	Relies on natural processes to reduce PCB concentrations.	All of these alternatives vary to the degree to which they address sources and protect human health and the environment over time. Alternative 3-V meets both the soft sediment SWAC and PCB targets. Alternative 3-IV-A achieves the soft sediment SWAC target of 0.5 ppm and meets the PCB mas target. Alternatives 3-1 through 3-IV would not remove sufficient contaminated sediment to achieve the soft sediment deposit SWAC target of 0.5 ppm or the PCB mass target of 88%. Since the Upper River is a dynamic environment, the more PCB mass removed from the system the better the long term effectiveness.					
Reduction of Contaminant Toxicity, Mobility or Volume through Treatment	All alternatives do not permanently and significantly reduce toxicity, mobility or volume of the hazardous substances through treatment as a principal element. Treatment is not practicable for any alternative. No alternative is any better than the others because none of the alternatives call for treatment prior to disposal.							
Short-term Effectiveness	Alternatives 1 and 2 require no time to implement the remedy and pose no risks to workers, residents and the environment since no excavation is required.		All of these removal alternatives vary to the degree to which they pose risks to workers implementing the remedy. The more PCB mass removed from the system the more time it will take to conduct the work and that will increase the potential for short term negative impacts to the river. Recreational activities in the Upper River would be disrupted during implementation. Removal of CTF/SMF sediment may include transportation spills however, the likelihood of such an event is of minimal concern. Alternatives 3-IV-A and 3-V will reach soft sediment protection levels upon completion of the remedy. Alternatives 2, 3-I, 3-II, 3-III, and 3-IV rely on natural processes to reach soft sediment protection levels. If these alternatives are implemented benthic habitat will be disturbed.					
Implementa-bility	No technical or administrative problems preventing implementation are foreseen for Alternatives 2 through 6. Services and materials are available for all alternatives. Implementation will be similar to what occurred during the removal action. Before remediation can take place, a WDNR- approved in-state disposal facility or out-of-state disposal facility must be located.							
Cost	$0	$4.5 million	$11.1 million	$13.8 million	$15.2 million	$19.1 million	$23.8 million	$25.6 million
State Acceptance	No	No	No	No	No	No	No	Yes

Nine Criteria	Alt. 1 No Action	Alt. 2 Natural Recovery and Monitoring	Alt. 3-I Removal of 34% of PCBs	Alt. 3-II Removal of 62% of PCBs	Alt. 3-III Removal of 72% of PCBs	Alt. 3-IV Removal of 78% of PCBs	Alt. 3-IV-A Removal of 88% of PCBs	Alt. 3-V Removal of 90% of PCBs
Community Acceptance	A complete summary of public comments can be found in the attached Responsiveness Summary.							

Middle River Sediment Comparative Analysis			
Nine Criteria	Alternative 1: No Action	Alternative 2: Characterization and Monitored Natural Processes	Alternative 3: Characterization, Sediment Removal and Monitored Natural Processes
Overall Protection of Human Health and the Environment	No risk reduction.	Current SWAC is 1.5 ppm based on RI data. Would meet the U.S. EPA soft sediment concentration SWAC target of 0.5 ppm which equates to a human health risk of 1.0 x 10-4 and falls within the LOAEL to NOAEL range for all aquatic receptors over time. Long-term monitoring will track sediment and fish concentrations over time.	Meets the U.S. EPA soft sediment concentration SWAC target of 0.5 ppm which equates to a human health risk of 1.0 x 10-4 and falls within the LOAEL to NOAEL range for all aquatic receptors upon completion of remedial action. Long-term monitoring will track sediment and fish concentrations over time.
Compliance with Applicable or Relevant & Appropriate Requirements (ARARs)	N/A	This alternative does not involve any further in-river remediation. It is expected that chemical- and location-specific ARARs would be met. Also, since further activity would be taken at the site, it is expected that action-specific ARARs would not be involved.	It is expected that this alternative could meet all chemical-, location-, and action-specific ARARs for the site over time. However, all of these alternatives hold the possibility for short-term exceedances of Wisconsin surface water quality standards. In addition, since the WDNR has identified the Sheboygan River areas as a possible habitat for some endangered species, it is possible that disruption or destruction of their habitat may occur through implementation of this alternative. However, reasonable precautionary measures would be undertaken to meet all chemical-, location-, and action-specific ARARs during implementation.
Long-term Effectiveness and Permanence	Existing risks will remain	Under this alternative, existing source has not been addressed. Relies on natural processes to reduce PCB concentrations to 0.5 ppm, or less, for soft sediment deposits. This will benefit the benthic community in the long run as a less contaminated and healthier substrate will be established for benthic populations.	PCB-contaminated soft sediment deposits would be removed to establish a soft sediment SWAC of 0.5 ppm. Over time natural processes would further reduce PCB concentrations. This will benefit the benthic community in the long run as a less contaminated and healthier substrate will be established for benthic populations.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	No alternative reduces toxicity, mobility, or volume of the hazardous substances through treatment as a principal element.		

Nine Criteria	Alternative 1: No Action	Alternative 2: Characterization and Monitored Natural Processes	Alternative 3: Characterization, Sediment Removal and Monitored Natural Processes
Short-term Effectiveness	Requires no time to implement and poses no risks to workers, residents and the environment since no excavation is required.	Requires no time to implement and poses no risks to workers, residents and the environment since no excavation is required. If the current Middle River SWAC is still near 1.5 ppm natural processes will be necessary to achieve soft sediment SWAC of 0.5 ppm over a longer term than currently anticipated. If current SWAC is significantly lower than 1.5 ppm, 0.5 ppm can be achieved in a shorter period of time.	Short term mobility of PCBs may increase as a result of sediment resuspension during dredging operations. Although some short-term effects inherent to dredging could be mitigated through daily monitoring, use of silt curtains, and implementation of the site-specific health and safety plan. Recreational activities in the Middle River would be disrupted during implementation. Middle River soft sediment SWAC of 0.5 ppm will be achieved upon completion of alternative. There will be short-term adverse impacts to the benthic habitat and community.
Implementability	No technical or administrative problems preventing implementation are foreseen for Alternatives 1 and 2. Service and materials are available for all alternatives. Before removal can take place, a WDNR-approved disposal facility must be located.		
Cost	$0 million	$2.0 million	$12.0 million
State Acceptance	No	No	No
Community Acceptance	A complete summary of public comments can be found in the attached Responsiveness Summary.		

Lower River & Inner River Sediment Comparative Analysis							
Nine Criteria	Alt. 1: No Action	Alt 2: Natural Recovery and Monitoring	Alt. 3: Sediment Trap	Alt 4: Removal of Sediment Disturbed by Natural and Recreational Impacts	Atl 5: Sediment Capping	Alt. 6: Removal of Surface Sediment	Atl. 7: Complete Excavation
Overall Protection of Human Health and the Environment	No risk reduction.	If the current Lower River SWAC is 5.5 ppm, then this alternative relies natural processes and the on the introduction of cleaner upstream sediments to achieve a Lower River SWAC of 0.5 over time. If NOAA samples taken in 1997 are more representative of the Lower River SWAC the 0.5 ppm may be achieved in a short period of time for the Lower River. Sediment and fish monitoring would track PCB levels over time.	This alternative would achieve a Lower River and Inner Harbor SWAC of 0.5 ppm over time through the introduction of cleaner upstream sediments. The sediment trap would add a risk management component to the overall river remedy and “trap” relatively small amounts of contaminated sediment in the Inner Harbor before migrating into Lake Michigan. Sediment and fish monitoring would track PCB levels over time.	This alternative is expected to achieve an Inner Harbor SWAC of 0.5 ppm upon completion of, or shortly after, remedial activities. This alternative will remove contaminated sediment in areas of the Inner Harbor that are vulnerable to recreational boating or scour. Sediment and fish monitoring would continue to track PCB levels over time. This alternative would achieve a Lower River SWAC of 0.5 ppm shortly after implementation, if NOAA’s samples taken in 1997, are more accurate	This alternative would achieve a Lower River and Inner Harbor SWAC of 0.5 ppm over time through the introduction of cleaner upstream sediments. This alternative would introduce a “protective layer” between the surface and the more highly contaminated sediments. Adding 32 inches of cap material over the Inner Harbor could significantly affect use of the boat moorings under low Lake Michigan water conditions. Sediment and fish monitoring would tack PCB levels over time.	This alternative would achieve an Inner Harbor SWAC of 0.5 ppm, or less, upon completion of remedial activities. This alternative would not remove additional contaminated sediment vulnerable to scour which could mean an increase in surface sediments in areas vulnerable to scour. Sediment and fish monitoring would continue to track PCB levels over time.	This alternative would achieve an Inner Harbor SWAC of 0.5 ppm, or less, upon completion of remedial activities. Sediment and fish monitoring would continue to track PCB levels over time.

Nine Criteria	Alt. 1: No Action	Alt 2: Natural Recovery and Monitoring	Alt. 3: Sediment Trap	Alt. 4: Removal of Sediment Disturbed by Natural and Recreational Impacts	Alt. 5: Sediment Capping	Alt. 6: Removal of Surface Sediment	Alt. 7: Complete Excavation
Compliance with Applicable or Relevant & Appropriate Requirements (ARARs)	These two alternatives do not involve any further in-river remediation. It is expected that chemical- and location-specific ARARs would be met. Also, since either minimal or no further activity would be taken at the site, it is expected that action-specific ARARs would not be involved.		These dredging alternatives could possibly involve short-term exceedances of the Wisconsin water quality standards. As with any treatment process, a temporary exceedance of permitted effluent levels may sometimes occur, although the facility would be properly maintained and operated. However, precautionary measures would be undertaken to comply with all ARARs.		This alternative would comply with all chemical-, location, and action- specific ARARs.	These dredging alternatives could possibly involve short-term exceedances of the Wisconsin water quality standards. As with any treatment process, a temporary exceedance of permitted effluent levels may sometimes occur, although the facility would be properly maintained and operated. However, precautionary measures would be undertaken comply with all ARARs.	
Long-term Effectiveness and Permanence	Under this alternative, contaminated sediment is not addressed and it relies on natural processes to reduce PCB concentration in surface sediments over time. Exposure to contaminated sediment due to recreational boating or scour would remain.	Like the no-action alternative, contaminated sediment is not addressed and it relies on natural processes to reduce PCB concentrations in surface sediments over time. Exposure to contaminated sediment due to recreational boating or scour would remain. Long term monitoring will track sediment and fish tissue concentrations.	Although some contaminated sediment will be removed to create the trap, like Alternatives 1 and 2, most of the surficial contaminated sediment is not removed. This alternative relies on natural processes to reduce PCB concentrations in surface sediments over time. Exposure to contaminated sediment due to recreational boating or scour will remain.	This alternative removes contaminated surficial sediment over approximately 45% of the Inner Harbor. It also removes contaminated sediment in areas of the Lower River and Inner Harbor that are vulnerable to recreational boat disturbances and scour during high flow events. Excavated areas will be backfilled with clean sediment.	While this alternative does not remove contaminated sediment, it wold create a barrier between what is currently in place and upstream sediment deposited in the future. Property designed, the cap would be expected to be effective. Implementation of the cap may interfere with the current recreational use of the harbor by some water craft.	This alternative removes the top 2 feet of sediment in the Inner Harbor, but would not remove sediment in areas subject to scour during high flow events causing the possible release of those sediments. Excavated areas would be backfilled with clean sediment. Exposure to contaminated sediment scour would remain. This alternative would rely on natural processes to reduce PCB concentrations in the Lower River.	This alternative removes all existing contaminated sediment from the Inner Harbor and would rely on natural processes to reduce PCB concentrations in the Lower River.

Nine Criteria	Alt. 1: No Action	Alt 2: Natural Recovery and Monitoring	Alt. 3: Sediment Trap	Alt. 4: Removal of Sediment Disturbed by Natural and Recreational Impacts	Alt. 5: Sediment Capping	Alt. 6: Removal of Surface Sediment	Alt. 7: Complete Excavation
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	Does not permanently or significantly reduce toxicity, mobility, or volume of the hazardous substances as a principal element.	None of the alternatives reduce toxicity, mobility or volume through treatment as excavated sediments are not planned to be treated prior to disposal.					
Short-term Effectiveness	These alternatives require no time to implement and pose no risk to workers, residents and the environment since no excavation is required. These alternatives may require natural processes to reach 0.5 ppm soft sediment SWAC and will take longer than to reach that sediment target than other more comprehensive alternatives.		All of these alternatives increase in short-term impacts as volume of contaminated sediment removed is increased. The likelihood of adverse impacts to the benthic community and potential releases of PCBs into the water column are similar for all of these alternatives. Removal of contaminated sediment or implementation of a sediment cap will disrupt recreational use of the Inner Harbor. Short-term effects could be minimized through daily monitoring, use of slit curtains, and implementation of a site-specific health and safety plan. Alternative 3 would require natural processes to reach 0.5 ppm soft sediment SWAC. Alternatives 4, 5, 6 and 7 would meet soft sediment SWAC target shortly after implementation.				
Implementability	Before removal can take place, a WDNR-approved disposal facility must be located. Before a sediment cap can be placed on contaminated sediment in the Inner Harbor this would have to be approved by the USACE as the Inner Harbor contains a Congressionally authorized navigation channel. Deauthorization of the navigational channel would be necessary before a cap can be installed.						
Cost	$0	$3.1 Million	$9.3 Million	$10.0 Million	$10.8 Million	$14.6 Million	$169.3 Million
State Acceptance	No	No	No	No	No	No	Yes
Community Acceptance	A complete summary of public comments can be found in the attached Responsiveness Summary.						

Floodplain Soil Comparative Analysis

<table>
<tr><th>Nine Criteria</th><th>Alt. 1:
No Action</th><th>Alt 2:
Bank Soil Stabilization</th><th>Alt. 3:
Removal of Soil Containing More than 50 ppm of PCBs</th><th>Alt. 4:
Removal of Soil Containing More than 10 ppm of PCBs</th></tr>
<tr><td rowspan="2">Overall Protection of Human Health and the Environment</td><td rowspan="2">No risk reduction.</td><td>This alternative is not protective of the ecological receptors based on the U.S. EPA terrestrial risk assessment.</td><td>This alternative is not protective of ecological receptors based on the U.S. EPA terrestrial risk assessment.</td><td>This alternative is protective of ecological receptors based on the U.S. EPA terrestrial risk assessment.</td></tr>
<tr><td colspan="3">All three floodplain alternative are protective of human health risks based on the 1993 U.S. EPA risk assessment.</td></tr>
<tr><td>Compliance with Applicable or Relevant & Appropriate Requirements (ARARs)</td><td>Since this alternative does not involve any active remediation, no action-specific ARARs would be triggered. It is expected that location-specific ARARs would also be met. This alternative may not comply with the chemical-specific Wisconsin Soil Cleanup Standards.</td><td>This alternative may not comply with the chemical-specific Wisconsin Soil Cleanup Standards.

This alternative would comply with chemical-specific ARARs for the site. This alternative would likely comply with action- and location-specific ARARs as well, through appropriate management of removed materials. However, it is possible that disruption or destruction of any identified endangered species and/or habitat could occur. However, precautionary measures would be undertaken to comply with action- and location- specific ARARs during implementation of this alternative.</td><td colspan="2">These alternatives would comply with chemical-specific ARARs for the site. These alternatives would likely comply with action- and location-specific ARARs as well, through appropriate management of removed materials. However, it is possible that disruption of any identified endangered species and/or habitat could occur. However, precautionary measures would be undertaken to comply with action- and location-specific ARARs during implementation of these alternatives.</td></tr>
<tr><td>Long-term Effectiveness and Permanence</td><td>Under this alternative, the source has not been addressed. Relies on natural processes to reduce PCB concentrations. Existing risk will remain.</td><td>Like the no-action alternative, source material is not addressed, allowing potential migration of PCB-contaminated soil from the floodplain areas to the river during high flow events. Bank stabilization would decrease soil erosion measures and provide additional protection to human health and the environment.</td><td colspan="2">The effects of these two alternatives involving excavation are expected to be prompt and permanent as PCB-contaminated soils are removed from the floodplain areas. Alternative 4 removes more material than Alternative 3 and will reduce PCB SWAC concentrations to levels necessary to meet the risk targets of ecological receptors.</td></tr>
</table>

Nine Criteria	Alt. 1: No Action	Alt 2: Bank Soil Stabilization	Alt. 3: Removal of Soil Containing More than 50 ppm of PCBs	Alt. 4: Removal of Soil Containing More than 10 ppm of PCBs
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	Does not permanently or significantly reduce toxicity, mobility, or volume of the hazardous substances as a principal element.	This alternative would remove approximately 670 cubic yards of PCB-contaminated soil.	This alternative would remove approximately 2,600 cubic yards of PCB-contaminated soil.	This alternative would remove approximately 10,800 cubic yards of PCB-contaminated soil.
		With each successive alternative more volume of PCB-contaminated soil is removed. The placement of appropriate soil erosion control measures would reduce the potential mobility of PCBs in the floodplain areas. Alternatives 3 and 4 remove significantly more PCB-contaminated soil. Under each alternative, excavated soil would be disposed of in a WDNR-approved facility and is not planned to be treated prior to disposal.		
Short-term Effectiveness	Require no time to implement and poses no risks to workers, residents and the environment since no excavation is required.	The short-term effects of excavation of the floodplain areas would likely include disruption/destruction of natural areas near the river to construct access roads and staging areas and potential spillage of soils into the river during removal or conveyance of soil across the river. Alternative 2 would not entail the disruption /destruction of as much natural area. Implementation of Alternatives 3 and 4 will be balanced with keeping as much high-quality habitat in place as possible. Reasonable and appropriate environmental control measures (i.e. slit curtains, hay bales) and a site-specific health and safety plan would be implemented as part of each removal alternative.		
Implementability	All floodplain soil alternatives involving excavation would not present issues with regard to implementability. Negotiations with affected landowner(s) would be necessary for gaining access.			
Cost	$0 million	$0.6 million	$1.8 million	$4.5 million
State Acceptance	No	No	No	Yes
Community Acceptance	A complete summary of public comments can be found in the attached Responsiveness Summary.			

Ground-water and Additional PCB Sources Comparative Analysis				
Nine Criteria	Alt. 1: No Action	Alt 2: Investigation / Source Identification and Control	Alt. 3: Collection Trench and Treatment	Alt. 4: Facility Perimeter Cut-off Wall
Overall Protection of Human Health and the Environment	No risk reduction.	Alternatives 2 through 4 may provide a similar level of protection from potential adverse effects of PCBs from contaminated ground-water, however, it is unclear whether complete exposure pathways between facility ground-water and the river currently exist. River bank samples taken in 1999 indicate an additional source from Tecumseh's Sheboygan Falls plant. Alternative 2 would allow for further investigations to determine what remedial measures are necessary to control or eliminate further introduction of PCB to the Sheboygan River. Alternatives 3 or 4 will be necessary if additional sourcing to the river is due to contaminated ground-water and natural attenuation is not an appropriate remedial alternative.		
Compliance with Applicable or Relevant & Appropriate Requirements (ARARs)	This alternative would not trigger action- or location- specific ARARs, since no active remediation would be conducted. PCB concentrations in Tecumseh's Sheboygan Falls plant ground-water exceed WDNR ES and thus are not assumed to be compliant with the chemical-specific ARAR. Natural process may reduce PCB concentrations over time.	Further sampling under this alternative may indicate that Tecumseh's Sheboygan Falls plant ground-water is compliant with all chemical-specific ARARs. If PCB concentrations found in Tecumseh's Sheboygan Falls plant ground-water still exceed the WDNR enforcement standard, then source identification and control and natural processes would be expected to reduce PCB concentrations over time.	Removed materials would likely comply with chemical-specific ARARs, as these materials would be handled and subsequently disposed in an appropriate landfill. Short-term exceedances of the Wisconsin surface water quality standards may occur upon discharge of treated water back to the River as part of alternative 3 and 4. Water would be treated through the existing CWTF, which consists of a BAT process. As with any treatment process, a temporary exceedance of permitted effluent levels may sometimes occur, although the facility (CWTF) would be properly maintained and operated. Removal activities would likely comply with action- and location-specific ARARs through appropriate management of removed materials. Precautionary measures implementation of these alternatives would be undertaken.	

Nine Criteria	Alt. 1: No Action	Alt 2: Investigation / Source Identification and Control	Alt. 3: Collection Trench and Treatment	Alt. 4: Facility Perimeter Cut-off Wall
Long-term Effectiveness and Permanence	Under this alternative, additional sources have not been addressed. If ground-water is contaminating the river, no action relies no natural processes to reduce PCB concentrations over time.	The Collection Trench and Treatment and Facility Perimeter Cut-off Wall alternatives would be maintained in operation until the calculated loading of Tecumseh's Sheboygan Falls plant ground-water discharges to the river is within acceptable limits. Source control measures implemented as part of the Investigation and Control alternative and the hydraulic control implemented as part of the Collection Trench and Treatment and Facility Perimeter Cut-off Wall alternatives would provide these alternatives with further effectiveness and permanence. However, the extent of any further effectiveness is unknown pending further investigations. The existing City of Sheboygan Falls ordinance provides some adequacy and reliability in terms of long-term control to limit potential future exposure to ground-water. Further limitations for exposure to ground-water could be achieved through deed restrictions. Ground-water monitoring would provide a means to track PCB concentrations in ground-water over time.		
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	Does not permanently or significantly reduce toxicity, mobility, or volume of the hazardous substances as a principal element.	Source control measures would further reduce the mobility and volume of PCBs that may be entering the river from the ground-water system. Ground-water collection and treatment, conducted as part of the Collection Trench and Treatment or Facility Perimeter Cut-off Wall alternatives may reduce the mass of PCBs in ground-water based on further investigations. However, due to the low PCB mobility, ground-water removal and treatment may not significantly reduce PCB mass in ground-water. Alternatives 3 and 4, however, would significantly reduce the volume of PCBs entering the Sheboygan River from the Tecumseh's Sheboygan Falls plant area.		
Short -term Effectiveness	Requires no time to implement and poses no risks to workers, residents and the environment since no excavation is required.	In general, Alternatives 2 through 4 should not increase risk to the community beyond the existing conditions. Risks associated with the installation of the Collection Trench or Facility Perimeter Cut-off Wall would be confined to the workers during the completion of additional monitoring and construction activities, and during treatment of water throughout an assumed 30-year period. A site specific health and safety plan would minimize potential exposure risks.		
Implementability	No Issues	The technical ability to monitor and install wells has been demonstrated at Tecumseh's Sheboygan Falls plant in the past. Essentially similar conditions are anticipated during implementation of excavation activities. The technical implement ability of additional source control measures would depend on the results of the additional investigations and necessary control measures. The technical implement ability of constructing a collection trench or a cut-off is not expected to be an issue. Equipment and services are expected to be available in sufficient supply to implement any of these alternatives.		
Cost	$0 million	$0.6 million	$1.5 million	$3.6 million

Nine Criteria	Alt. 1: No Action	Alt 2: Investigation / Source Identification and Control	Alt. 3: Collection Trench and Treatment	Alt. 4: Facility Perimeter Cut-off Wall
State Acceptance	No	Yes	Yes	Yes
Community Acceptance	A complete summary of public comments can be found in the attached Responsiveness Summary.			

K. PRINCIPAL THREAT WASTES

The NCP establishes an expectation that U.S. EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). The “principal threat" concept is applied to the characterization of “source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, surface water, or air, or acts as a source for direct exposure. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur.

Although no "threshold level" of risk has been established to identify principal threat waste, a general rule of thumb is to consider as a principal threat those source materials with toxicity and mobility characteristics that combine to pose a potential risk several orders of magnitude greater than the risk level that is acceptable for the current or future site use.

Based on human health risks at the Sheboygan River and Harbor site, the threshold risk level of 1×10^{-4} equates to a sediment PCB contaminant level of approximately 0.5 ppm. Accordingly, contaminated sediment with levels exceeding 50 ppm may be determined to be a principal threat waste. However, the highest LOAEL for the most sensitive ecological receptor analyzed by NOAA was approximately 1.0 ppm. Based on ecological risks, contaminated sediment with levels exceeding 100 ppm may be considered a principal threat waste for ecological receptors. Therefore, the lower of the two thresholds, 50 ppm, is considered principal threat waste in areas subject to mobility due to human and natural disturbances. The dynamic nature of the Upper and Middle River portions of the site make soft sediment deposits in both of these river reaches vulnerable to natural disturbances. Low water levels in the Lower River and Inner Harbor make some areas within these river reaches vulnerable to recreational and natural disturbances.

L. SELECTED REMEDY

This section of the ROD will be organized into three sections: 1) Description and Rationale for the Selected Remedy, 2) Summary of the Estimated Remedy Costs, and 3) Expected Outcomes of Selected Remedy

Summary and Description of the Rationale for the Selected Remedy

The summary of the rationale for the selected remedy will be addressed for each site component.

Upper River Sediments

The remedy for this river component is to re-characterize the Upper River and remove a minimum of 88 percent of the remaining PCB mass in the soft sediment deposits to remove mobile mass and achieve a soft sediment SWAC in the Upper River of less than or equal to 0.5 ppm. U.S. EPA estimates that approximately 20,774 cubic yards will be removed from the Upper River soft sediment deposits to achieve this goal. U.S. EPA expects that removal of this amount of remaining PCB mass will result in an overall PCB sediment SWAC of 0.5 ppm in the Upper River over time. Because some PCB mass will remain in place, a 30 year monitoring program will be implemented to monitor sediment and fish tissue concentrations to ensure that over time the entire river will reach an average PCB sediment concentration of 0.5 ppm or less, and that over time fish consumption advisories will be phased out.

The U.S. EPA selects a remedy for this river component which emphasizes the removal of soft sediment deposits as these areas act as a PCB source for the rest of the river. PCB contamination is found in both the soft sediment deposits and scattered soft sediment in the non-soft sediment areas of the river, or described hereafter as the hard sediments. The approximate surface area represented by the soft sediment deposits is 15 percent, with the hard sediment area representing the remaining 85 percent in the Upper River. See Appendix D of the 1998 FS for a detailed explanation of this approach. PCB contamination levels vary throughout the entire river. Based on sampling conducted by the WDNR in 1997, surficial PCB contamination, in the hard sediment area ranged from 0.3 ppm to 5.3 ppm, averaging 2.5 ppm for the 10 samples taken over the 3.8 mile stretch of the Upper River.

To determine an overall river SWAC, PCB contamination in the soft sediment deposits and hard sediments are prorated to account for their overall effect on the aquatic receptors. The FS used the two dimensional surface area of the soft sediment deposits and hard sediment area which equalled 15 percent for the soft sediment deposits and 85 percent for the hard sediments. The FS recommended alternative 3-II. This alternative includes the removal of approximately 7,500 cubic yards of PCB-contaminated soft sediment which reduces the soft sediment deposit SWAC to 2.8 ppm. Implementing this alternative will result in an overall Upper River SWAC of 2.55 ppm upon completion of remedial activities in the Upper River.

Overall Upper River SWAC = (Ave. Soft Sediment Deposit Concentration x 15%) +
(Ave. Hard Sediment Concentration x 85%)

Overall Upper River SWAC = (2.8 ppm x 0.15) + (2.5 ppm x 0.85) = 2.55 ppm

Removing approximately 20,774 cubic yards results in a soft sediment deposit SWAC of 0.5 ppm. A soft sediment deposit SWAC of 0.5 ppm results in an overall Upper River SWAC of 2.20 ppm.

Overall Upper River SWAC = (0.5 ppm x 0.15) + (2.5 ppm x 0.85) = 2.20 ppm

These two soft sediment deposit targets don't yield a significant difference in the overall river SWAC if a 15 percent / 85 percent SWAC ratio is assumed. However, a 15 percent factor likely under represents the risk impact of PCBs in these soft sediment deposits. There are a number of reasons for this.

- The proposed 15 percent / 85 percent weighting approach assumes a static model and is inappropriate for a dynamic river system. The soft sediment PCBs are more likely to be mobilized and transported in comparison with hard sediment PCBs. This difference in mobility is not accounted for by the 15 percent / 85 percent surface area weighting. During sediment investigations, conducted as part of the NOAA Aquatic Risk Assessment in July and August of 1997, NOAA and WDNR staff observed that soft sediment deposits had significantly shifted or had been significantly disturbed in portions of the Upper River demonstrating the mobility of these soft sediment deposits.

- The proposed 15 percent / 85 percent weighting approach does not address source control, that is, PCB-contaminated soft sediment deposits are the most likely source of fine grained silts and clays in the hard sediment area.

  An analogy would be a large pile of contaminated dirt from which a plume of dirt has been blown off downwind. The plume of blown-off dirt would appear to be the major repository of contaminants based solely on an aerial comparison of the two-dimensional surface area of the pile versus the area of the plume. Emphasizing remedial efforts on the plume as a result of this two dimensional comparison would be a mistake. In contrast, consideration of mass and potential mobility would correctly focus the cleanup efforts on the pile, and secondarily on the dispersed plume.

- The proposed 15 percent / 85 percent weighting approach does not take into account the actual spatial dispersion of soft sediment in the hard sediment area. PCBs are unlikely to occur in truly hard bottoms. They are more likely presented in scattered inclusions of fine sediments in the hard sediment areas. If so, it is inappropriate to compare the total area of hard sediments with the surface area of soft sediment deposits. It is more likely that the average PCB concentration for the hard sediment area is lower than the 2.5 ppm estimated if the soft sediment within the hard sediment area was accurately estimated. This would then mean that overall Upper River SWAC of 2.20 currently overestimated. However, even this adjustment for the spatial dispersion of soft sediments in the hard sediment area would not address the source concern discussed previously.

- The proposed 15 percent / 85 percent weighting approach does not accurately account for the ecological risks for many of the fish species that reside in the Sheboygan River. Information submitted by Blasland, Bouck & Lee, Inc. (BBL), administrative record update #3, Item # 41, indicates that smallmouth bass prefer the hard sediment areas which BBL contends supports the Feasibility

Study (FS) 15 percent / 85 percent SWAC weighting. However, state-wide surveys of fish species reported to forage in the Sheboygan River show that even smallmouth bass often frequent sand/silt/mud areas greater than the 15 percent assigned to the soft sediment deposits. Exhibit 2 shows the frequency of soft bottom types associated with various fish species in the Sheboygan River.

- The proposed 15 percent / 85 percent weighting approach underestimates risks to other wildlife. This is especially true for piscivorus wildlife such as the mink and blue heron. The food chains for both species are linked to soft sediments. It is the PCBs associated with soft sediments, not a weighted average concentration, which are available to these species. The blue heron is an opportunistic feeder that utilizes sight to locate prey. It dose this by wading or standing and waiting for prey. Such feeding behavior requires still or slow moving water so that prey may be observed and captured. This type of feeding strategy cannot be efficiently implemented in the riffle areas, which are associated with hard sediments. Unlike the blue heron, mink are capable of consuming large prey such as carp, which will also be more closely associated with soft sediments.

Table 14 - Summary of SWAC Analysis

	Overall River SWAC Based on Post-Remediation Soft Sediment SWAC of	
Soft sediment vs. Non-Soft Sediment Weighting	2.8 ppm	0.5 ppm
15% / 85%	2.55	2.20
25% / 75%	2.58	2.00
50% / 50%	2.65	1.50
75% / 25%	2.73	1.00
85% / 15%	2.76	0.80

Based on all of this information, soft sediment deposits likely play a much larger role in risks to the river system than the 15 percent attributed to them in the FS and will vary depending on the receptor analyzed. Table 14 demonstrates that the greater the weighting of the soft sediment deposits in the overall river SWAC calculation, the more significant removal of the soft sediment deposits becomes. The qualitative information presented earlier indicates that the soft sediment deposits likely have a greater impact than the 15 percent that the FS assigns.

In summary, the remedy for the Upper River removes a minimum of 88 percent of the remaining mass in the soft sediment deposits to achieve a soft sediment deposit SWAC in the Upper River of 0.5 ppm or less. Removing 88 percent of the remaining PCB mass is likely to result in an overall Upper River SWAC of 0.5 ppm, or less, shortly after remediation because the average PCB concentration of 2.5 ppm for the hard sediments is likely overstated as it doesn't account for the actual spatial distribution of soft sediment in the hard sediment area.

In developing sediment removal alternatives, the PRP used 1997 data and calculated the PCB mass for each of the soft sediment deposits in the Upper River. The soft sediment deposits were sorted from the largest to smallest PCB mass. Next, the deposits were evaluated based on access area "groupings" (i.e., grouping areas with higher masses that may be accessed from the same access areas). The areas were plotted as mass removed (and percent mass reduction) per sediment volume removed, where steeper/similarly sloped areas (i.e., largest reduction in PCB mass per cubic yard of sediment removed) were combined at the beginning of the curve. This approach to sediment removal is shown graphically in Figure 5. Exhibit 3 of this ROD shows the specific soft sediment deposits assigned to each FS Upper River removal alternative.

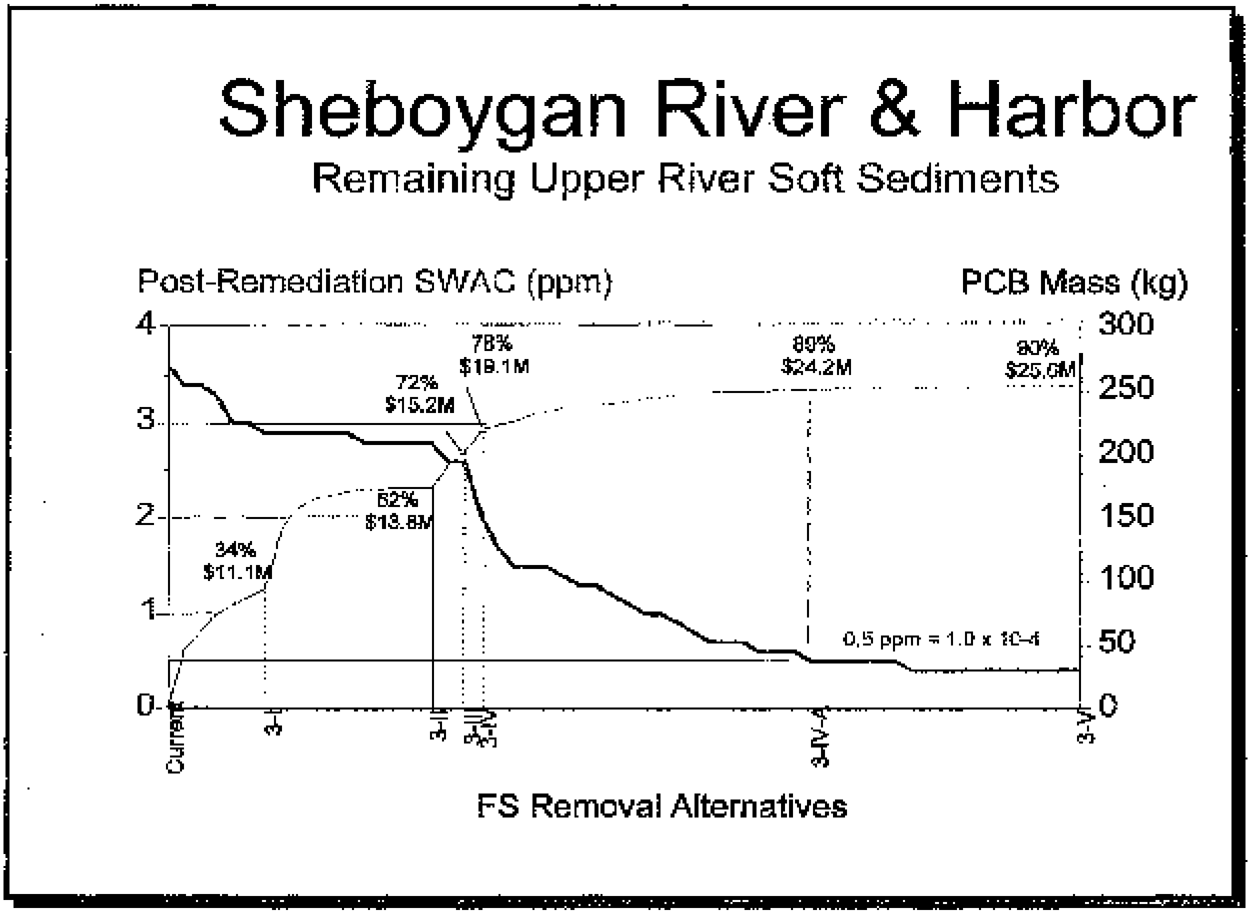

Figure 5

The U.S. EPA evaluated twelve additional soft sediment removal approaches to determine if similar SWAC and PCB mass targets could be achieved for less cost. An evaluation describing these approaches is in Administrative Record Update #5. The additional approaches included focusing on soft sediment SWAC reduction, PCB mass reduction, and combinations of SWAC and mass reduction. In evaluating these different approaches, focusing the order of soft sediment deposits to reach a PCB concentration of 1.0 ppm and then reordering the remaining deposits to focus on PCB mass removal yielded similar results at a slightly lesser cost. This approach is shown graphically in Figure 6, while the specific soft sediment deposit order is in Exhibit 4.

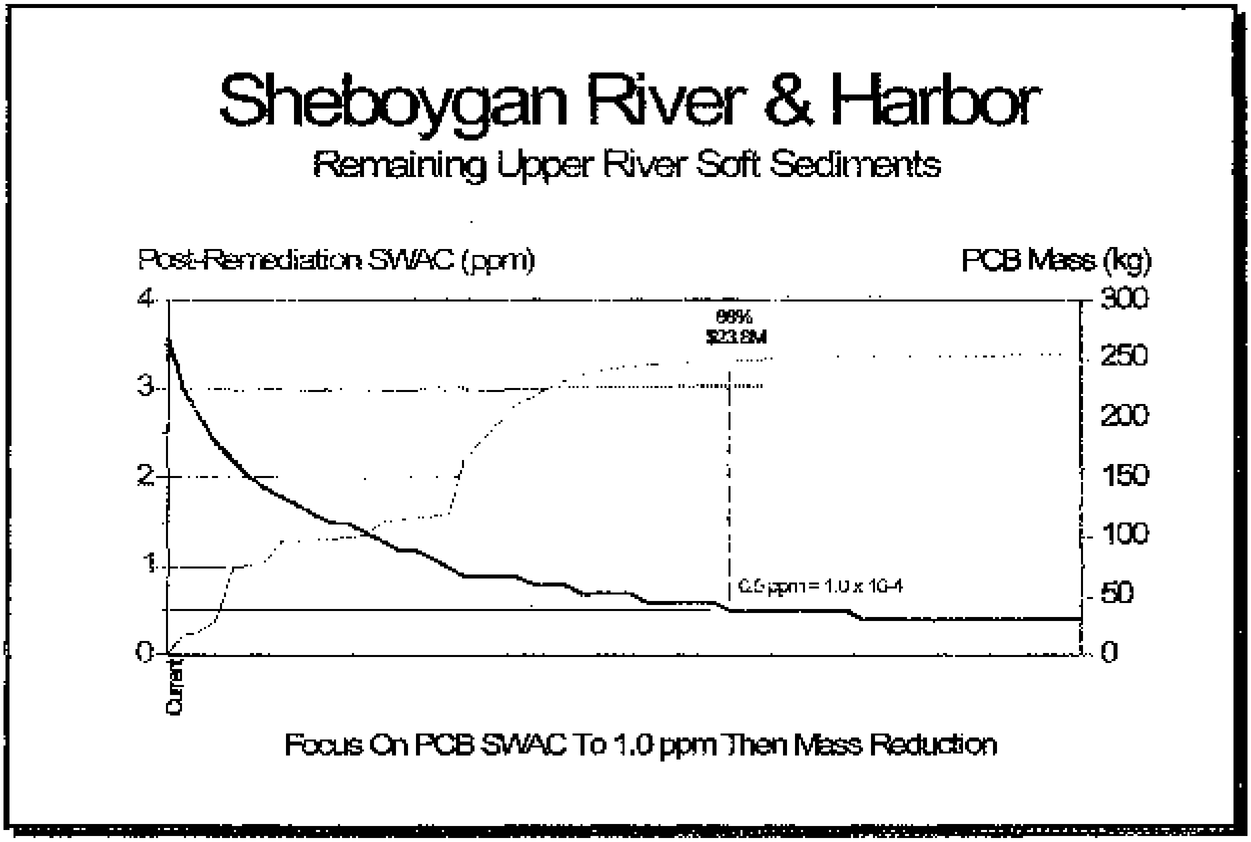

Figure 6

This removal approach has an estimated cost of $23,800,000 and gives the most economical cost per PCB mass of the thirteen approaches analyzed. This approach is approximately $300,000 less than the FS approach and the reduction in cost is due to the removal of less sediment.

The selected remedy for the Upper River is Alternative 3-IV-A, based on the SWAC and mass reduction approach presented in Figure 6. This approach removes an estimated 20,744 cubic yards of PCB-contaminated sediment containing 88 percent of the Upper River's remaining PCBs.

Upper River Selected Remedy : Alternative 3-IV-A

Estimated Capital Cost: $30.6 million
Annual O & M Cost: $140,000 or $175,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $23.8 million.
Estimated time to Implement: 60 months

Removal of 88 percent of the remaining PCBs in the Upper River will be required to achieve a PCB soft sediment deposit SWAC 0.5 ppm for the Upper River. Under this alternative, the areas capped/armored during ASRI/removal action activities will be removed, including Area 1. Sediment removal under this alternative requires five access points along the Upper River. Annual fish sampling will occur until fish consumption advisories are lifted. Sediment samples will be taken at least once every five years, after dredging is complete, to document natural processes and to ensure that over time the entire river will reach an average PCB sediment concentration of 0.5 ppm, or less, and that over time fish consumption advisories will be phased out.

Middle River Sediments

The makeup of the Middle River is similar to the Upper River with distinct soft sediment and hard sediment areas. Soft sediment, in the Middle River, is generally deposited intermittently in a relatively thin or shallow layer along the river banks. The remedial objective of the Middle River is similar to the Upper River and is to achieve a Middle River soft sediment SWAC of 0.5 ppm. While the Middle River contains PCB source material, the PCB concentrations are generally less than the Upper River. While there is more soft sediment, approximately 35,000 cubic yards in the Middle River, versus 22,500 cubic yards in the Upper River, the 35,000 cubic yards is stretched over 7 miles, versus 22,500 cubic yards over 4 miles in the Upper River.

As described under, Section E. Site Characterization, PCB concentrations have historically ranged from non-detdct to 37 ppm in the Middle River. Exhibit 5, attached to the ROD, shows the Middle River SWAC calculations based on information obtained during site investigations. The PCB concentration for each deposit is from the May 1990 Remedial Investigation/Enhanced Screening (RI/ES) Report and soft sediment deposit volume figures come from Table B-2 of the FS. Using this information, the estimated 35,000 cubic yards of soft sediment contains roughly 60 kg of PCBs and has a soft sediment SWAC of 1.5 ppm. To achieve a PCB soft sediment SWAC of 0.5 ppm, an estimated 12,500 cubic yards of sediment, equaling 31 kg, must be removed. The soft sediment deposits targeted for removal are scattered along the entire 7 smile stretch and would likely require 4 access points to remove these soft sediments. Using the cost assumptions outlined in the FS, characterization of the Middle River and removal of soft sediment to achieve a soft sediment SWAC of 0.5 ppm costs $12.0 million dollars. This includes 30 years of sediment and biota monitoring (Middle River Alternative 3). Characterization and long-term sediment and biota monitoring for the Middle River costs $1.9 million dollars (Middle River Alternative 2).

Thirty-one kilograms of PCBs make up the difference between an estimated SWAC of 1.5 ppm and 0.5 ppm. In evaluating the five balancing criteria, the relatively small amount of PCBs over seven miles do not represent a significant concern with regards to the long-term effectiveness of reaching 0.5 ppm for this river component or other river components downstream. In addition, as indicated by more recent data for other parts of the river, it is likely that current soft sediment SWAC is lower than 1.5 ppm estimated using the FS data. Since the targeted soft sediment deposits are scattered along the entire Middle River, four access points are necessary, raising implementability concerns. Considering all of these issues and because contamination will be left in place, the U.S. EPA selects Alternative 2: Characterization and Monitored Natural Processes for the Middle River.

Middle River Selected Remedy: Alternative 2

Estimated Capital Cost: $0
Annual O & M Cost: $140,000 or $175,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $2.0 million.
Estimated time to Implement: 0 years

Due to the presence of PCB contamination and the dynamic nature of the river, this component of the river will be characterized to establish a baseline for evaluating natural process trends and tracking soft sediment concentrations toward a soft sediment SWAC of 0.5 ppm for the Middle River over time. Within the last few years, high flow events may have significantly disturbed and redistributed soft sediment in the Middle River. In addition, contaminated sediment from the Upper River portion of the site may have migrated to the Middle River and with the identification of possible continuing sources near Tecumseh's Sheboygan Falls plant in the spring/summer of 1999, characterization of the Middle River may reveal areas of more highly contaminated sediment. If during baseline characterization PCB concentrations equal to or greater than 26 ppm are found, these soft sediment deposits will be removed as they would significantly impair the overall Middle River soft sediment SWAC from achieving a PCB concentration of 0.5 ppm, or less over time. An explanation of the 26 ppm trigger is found on page 79.

An extensive monitoring program would be implemented to gauge the condition of the river and potential human health impacts over time. Long-term monitoring will provide valuable information on changing conditions that may warrant removal of PCB-contaminated sediment. Annual fish sampling will be occur until fish consumption advisories are lifted. Sediment samples will be taken every five years to document natural processes and to ensure that over time the entire river reaches an average PCB sediment concentration of 0.5 ppm, or less, and that over time fish consumption advisories will be phased out.

Lower River and Inner Harbor

Lower River

The Lower River remedy includes characterization and a PCB soft sediment SWAC of 0.5 ppm, or less over time. Unlike the Upper and Middle River segments, the Lower River contains a more continuous soft sediment river bottom. The river flow is less dynamic but soft sediment may be vulnerable to high flow events or boat traffic. Since the Lower River was never dredged by the U.S. Army Corps of Engineers like the Inner Harbor has been, the Lower River is at a state of dynamic equilibrium, meaning high flow events to boating traffic likely change the profile of soft sediments from year to year. There is no bathymetric data to show how the sediment bed has changed over time and if certain portions of the Lower River are susceptible to scour during high flow events or from boat traffic.

Using information from the RI/ES Report and Feasibility Study, a SWAC was calculated for the Lower River. This information is contained in Exhibit 6. According to the information, the Lower River soft sediment PCB SWAC is 5.5 ppm. To achieve a soft sediment PCB SWAC of 0.5 ppm, U.S. EPA estimates that 127,000 cubic yards of sediment must be removed.

As part of the aquatic risk assessment, NOAA took soft sediment samples in the Lower River in 1997. A comparison of the PCB sediment data is shown in Table 15.

Table 15 - Comparison of Lower River Surface Sediment Data (ppm)

1990 RI/ES		1997 NOAA Aquatic Risk Assessment	
Location	**PCB Concentration**	**Location**	**PCB Concentration**
R73 / R74	6.3 / 5.5	T09	0.3
R77 / R78	4.4 / 0.2	T10	0.2
R80 / R81	11.0 / 0.1	S5-4	1.0
R88	4.2	S5-5	0.6
R90 / R91	8.7 / 1.9	T11	0.2
R94	11.0	T12	0.2
R95 / R96 / R97	0.5 / 8.9 / 2.0	T13	0.4
N/A	N/A	T14	0.5

Table 15 - Comparison of Lower River Surface Sediment Data (ppm)			
1990 RI/ES		1997 NOAA Aquatic Risk Assessment	
Location	**PCB Concentration**	**Location**	**PCB Concentration**
N/A	N/A	T15	0.4
R98	2.3	T16	0.4
R100 / R101	5.7 / 0.9	T17	0.4

A review of the data shows that for the 10 samples NOAA obtained, PCB concentrations in surface sediment have dropped off significantly from the time sediment was obtained during the RI/ES. A Lower River SWAC cannot be recalculated using the NOAA data, because the data set is too limited. It does indicate, however, that PCB concentrations in surficial soft sediments are likely to be near 0.5 ppm or less for the Lower River and that the 0.5 ppm SWAC target may already be achieved in the Lower River. But because the more recent data is limited, the Lower River will be characterized to get an accurate picture of PCB concentrations in both surficial and sediments at depth. In addition, annual bathymetrys of the Lower River will be conducted to track sediment bed changes over time and determine if any areas of the Lower River are susceptible to scour that might disturb or resuspend soft sediment with higher concentrations of PCBs below the surface.

A prop wash analysis, for the Inner Harbor, was submitted by BBL during the public comment period indicating that soft sediments within the top 1 foot are subject to disturbance by recreational boats. The USACE reviewed the analysis and generally concurred with the conclusions of the analysis. One important assumption made in the prop wash analysis is the assumption that water depths are five feet or greater. While this is accurate for much of the Inner Harbor, a significant portion of the Lower River may have less than 5 feet of water. Since the prop wash analysis assumed a minimum water depth of 5 feet and much of the Lower River may have less than 5 feet of water, the disturbances due to prop wash may be greater than the top 1 foot calculated.

Since the river is a dynamic environment and significant time has lapsed since it was last characterized, the Lower River will be characterized to obtain an accurate picture of contaminant distribution in soft sediments and to determine if removal of PCB-contaminated soft sediment deposits is warranted. PCB-contaminated sediment in excess of 26 ppm within the top foot will be removed where water depths are greater than 5 feet and PCB-contaminated sediment in excess of 26 ppm within the top two feet will be removed where water depths are less than 5 feet. An explanation of the 26 ppm PCB trigger is on page 79. Any excavated areas of the Lower River will be backfilled with clean sediment in a manner to minimize resuspension or disturbance of any remaining contaminated sediments.

Excavation depths and volumes may be increased if through a bathymetry analysis, certain sediment areas are subject to scour greater than the effects of boat disturbance and those areas coincide with areas of high PCB concentration, or if it is determined through a re-evaluation of the Lower River sediment data that soft sediment must be removed to achieve a PCB soft sediment SWAC of 0.5 ppm. This may take the form of an Explanation of Significant Differences (ESD) or ROD Amendment. Lastly, like the Upper River reaches, since contamination is left in place, the Lower River will undergo a long-term monitoring program to assess sediment and fish tissue concentrations over time.

Inner Harbor

Like the other areas of the river, the overall goal is to achieve an overall PCB soft sediment SWAC of 0.5 ppm for this river component. The Inner Harbor is covered by a continuous layer of soft sediment. Soft sediment depths range from less than 1 foot to over 20 feet. The highest levels of PCB contamination are generally many feet below the sediment surface with lesser contaminated sediment at the surface. Although limited in quantity, surface samples (top 6 inches) obtained in 1999, by Tecumseh, showed PCB concentrations ranging from 0.38 ppm to 5.3 ppm. The range is not much different than 1987 Inner Harbor surface sampling results showing PCB concentrations between 0.17 to 5.8 ppm.

Table 16 shows PCB concentrations at various depths in the Inner Harbor. The analysis includes Inner Harbor data as far back as 1979. All sediment column data has been repositioned to account for changes in the bathymetry between the year the data was taken and 1999. The concentrations shown in Table 16 were generated by Earth Vision software and are based on sediment data from1979 through 1999. The analysis reveals that, on average, PCB surface concentrations between the Pennsylvania Avenue and 8th Street Bridges are higher than between the 8th Street Bridge and the Inner Harbor mouth. As an example, the average concentration in the top foot is estimated to be 11.8 ppm between Pennsylvania Avenue and 8th Street and 1.3 ppm between 8th Street and the Inner Harbor mouth. These estimates are based on the original data sets and would not account for concentration changes over time due to deposition, scour and mixing. However, PCB-contaminated sediment deeper than 5 or 6 feet is unlikely to have changed significantly based on an analysis of the annual bathymetry obtained by the USACE. Earth Vision estimates indicate that there are likely a number of areas of higher PCB contamination near the surface between the Pennsylvania Avenue and 8th Street Bridges than between the 8th Street Bridge and Inner Harbor mouth.

Table 16- PCB Concentration At Various Depths in the Inner Harbor Based on Earth Vision									
Sediment Depth	Entire Inner Harbor			Penn. Avenue to 8th St.			8th St. to Harbor Mouth		
	Ave.	Min.	Max.	Ave.	Min.	Max.	Ave.	Min.	Max.
0 to 1 foot	6.5	ND	117.4	11.8	ND	117.4	1.3	ND	9.5
1 to 2 feet	7.9	ND	89.1	15.7	ND	89.1	2.4	ND	15.1
2 to 4 feet	10.7	ND	103.2	19.1	ND	103.2	4.8	ND	37.3
4 to 6 feet	13.6	ND	82.5	20.2	ND	82.1	8.9	ND	82.5
6 to 8 feet	16.3	ND	135.2	20.0	ND	92.0	13.8	ND	135.2
8 to 10 feet	18.8	ND	167.4	19.0	ND	99.9	18.7	ND	167.4
10 to 12 feet	20.8	ND	148.4	19.0	ND	109.5	22.1	ND	148.4
12 to 14 feet	23.4	ND	173.7	22.2	ND	105.2	24.2	ND	173.7

Information was obtained from the City of Sheboygan marina to determine the water depths necessary for different vessels using the marina. Table 17 shows the approximate percentage of water depth necessary for motor boats and sailboats using the marina.

Table 17- Inner Harbor Recreational Boat Stats

Water Depth	Motor Boats	Sail Boats
10 feet	99.9%	99.9%
7 feet	99.9%	95%
5 feet	80%	70%

Water depths in the Inner Harbor range from approximately 1 foot to 17 feet, with the shallower water depths found between the Pennsylvania Avenue and 8th Street Bridges. As mentioned earlier, the prop wash analysis submitted by BBL computed that the top 1 foot of sediment is vulnerable to disturbances from boats. The prop wash analysis assumed a minimum water depth of 5 feet which is generally accurate for the Inner Harbor except for an area near the Pennsylvania Avenue Bridge or on the inside bend near the 8th Street Bridge as seen in Figure 6.

An analysis of bathymetric surveys produced by the USACE, showed that over the last 20 years, the Inner Harbor has been primarily depositional in nature with over 185,000 cubic yards of additional sediment settling into the Inner Harbor. See Figure 7. However, very little deposition has occurred between the Pennsylvania Avenue and 8th Street Bridges since 1991. In fact, some areas have undergone as much as 3 to 4 feet of scour. On the other hand, Figure 8, shows that since 1991 up to 3 to 4 feet of additional deposition has occurred between the 8th Street Bridge and the Inner Harbor mouth.

Dividing the 20 year period into shorter time intervals reveals that deposition and scour are scattered and sometimes cyclical. Areas scoured one year get filled in the next and vice versa. As seen in Figure 9, between 1997 and 1998, a significant portion of the entire Inner Harbor underwent scour. As seen in Figure 10, between 1998 and 1999 scour and deposition areas were less significant. Based on the review of Inner Harbor bathymetrys, burial of contaminated sediments will not be significant between the Pennsylvania Avenue and 8th Street Bridges, or for approximately 40 percent of the Inner Harbor. This area of the Inner Harbor is likely near it's dynamic equilibrium. Between the 8th Street Bridge and Inner Harbor mouth, water depths are generally 10 feet or greater and additional deposition is expected to continue to occur. The bathymetric analyses show that scour has occurred within the Inner Harbor. The maximum storm event that occurred during the period when bathymetric measures were recorded was a 34-year storm event in 1998 (Holmstrom, B.K., Olson, D.L. and Ellefson, B.R., 1998, Water Resources Data Wisconsin Water Year 1998: U.S. Geological Survey Water - Data Report WI-98-1, pages 5 & 6).

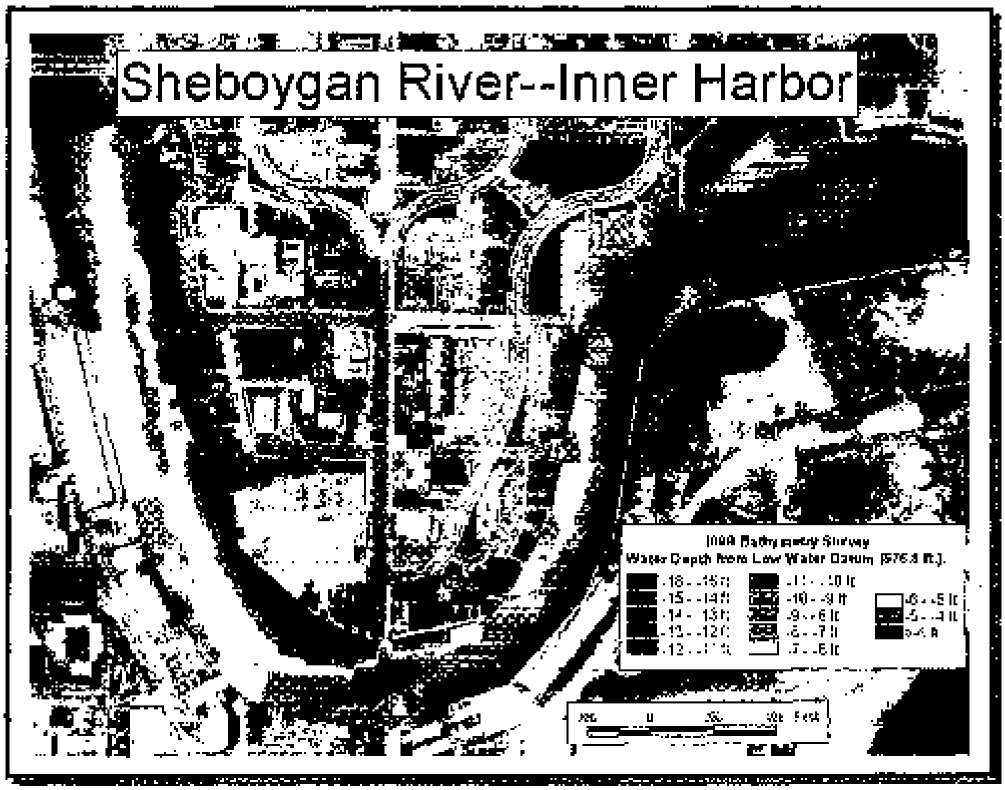

Figure 6

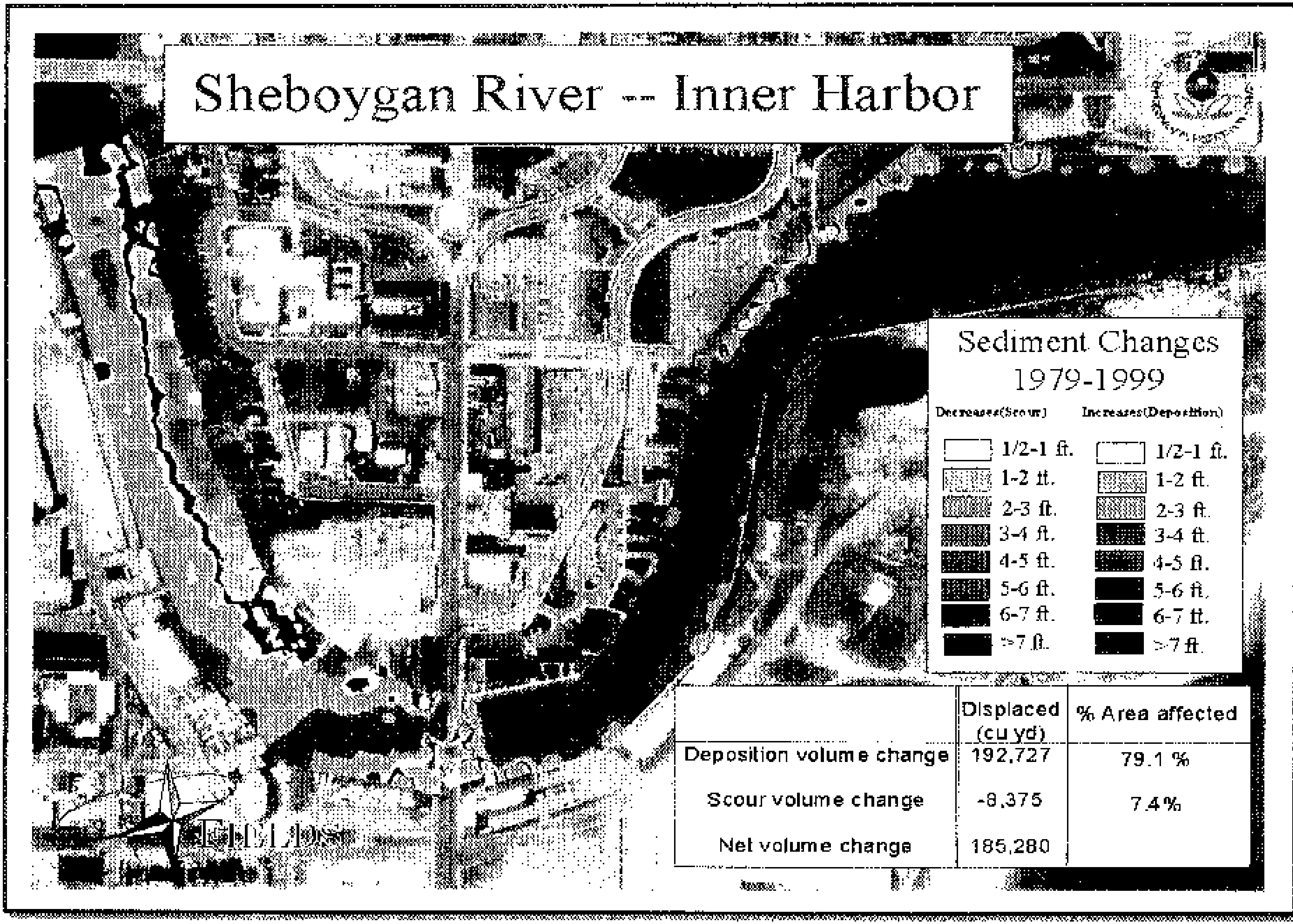
Sheboygan River -- Inner Harbor
Sediment Changes
1979-1999
Decreases(Scour)
Increases(Deposition)
1/2-1 ft.
1-2 ft.
2-3 ft.
3-4 ft.
4-5 ft.
5-6 ft.
6-7 ft.
>7 ft.
1/2-1 ft.
1-2 ft.
2-3 ft.
3-4 ft.
4-5 ft.
5-6 ft.
6-7 ft.
>7 ft.
Displaced (cu yd)
% Area affected
Deposition volume change
192,727
79.1 %
Scour volume change
-8,375
7.4%
Net volume change
185,280

Figure 7


Sheboygan River -- Inner Harbor
Sediment Changes
1991-1998
Decreases(Scour)
Increases(Deposition)
1/2-1 ft.
1-2 ft.
2-3 ft.
3-4 ft.
4-5 ft.
5-6 ft.
6-7 ft.
>7 ft.
1/2-1 ft.
1-2 ft.
2-3 ft.
3-4 ft.
4-5 ft.
5-6 ft.
6-7 ft.
>7 ft.
Displaced (cu yd)
% Area affected
Deposition volume change
59,660
49.7%
Scour volume change
-4,466
5.5%
Net volume change
60,149

Figure 8


Sheboygan River -- Inner Harbor
Sediment Changes
1997-1998
Decreases(Scour)
Increases(Deposition)
1/2-1 ft.
1-2 ft.
2-3 ft.
3-4 ft.
4-5 ft.
5-6 ft.
6-7 ft.
>7 ft.
1/2-1 ft.
1-2 ft.
2-3 ft.
3-4 ft.
4-5 ft.
5-6 ft.
6-7 ft.
>7 ft.
Displaced (cu yd)
% Area affected
Deposition volume change
16,421
19.5%
Scour volume change
-4,848
6.2%
Net volume change
12,519

Figure 9

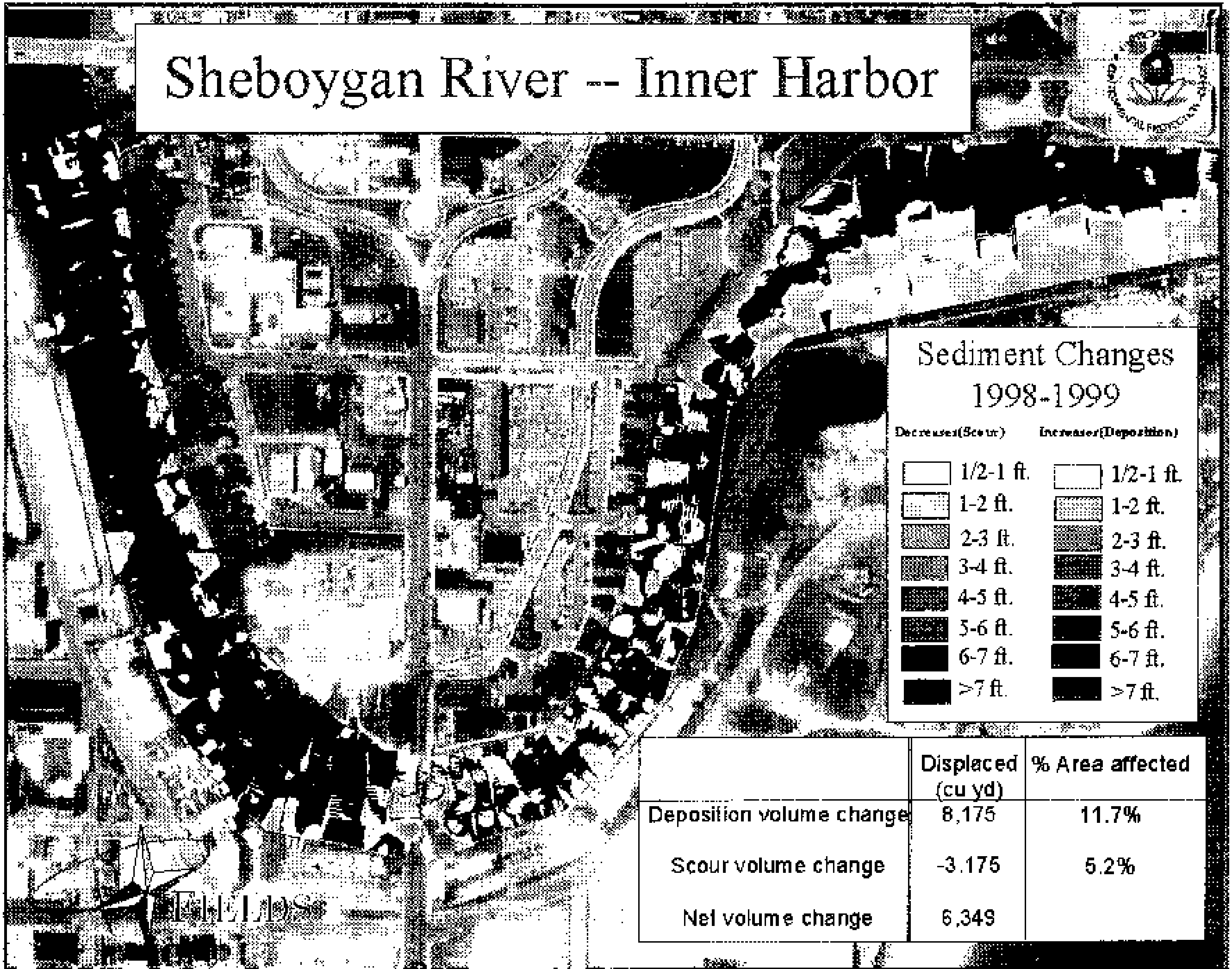
Sheboygan River -- Inner Harbor
Sediment Changes
1998-1999
Decreases(Scour)
Increases(Deposition)
1/2-1 ft.
1-2 ft.
2-3 ft.
3-4 ft.
4-5 ft.
5-6 ft.
6-7 ft.
>7 ft.
1/2-1 ft.
1-2 ft.
2-3 ft.
3-4 ft.
4-5 ft.
5-6 ft.
6-7 ft.
>7 ft.
Displaced (cu yd)
% Area affected
Deposition volume change 8,175 11.7%
Scour volume change -3,175 5.2%
Net volume change 6,349
FIELDS

Figure 10

Based on this information and evaluating the existing alternatives, the U.S. EPA selects Alternative 4: Lower River and Inner Harbor Sediment Removal Subject to Natural and Recreational Disturbances.

> ***Lower River & Inner Harbor Selected Remedy: Alternative 4***
>
> *Estimated Capital Cost: $12.1 million*
> *Annual O & M Cost: $201,300 or 237,000*
> *Duration of O & M: 30 years*
> *Total Present Value (7% discount rate): $10.0 million.*
> *Estimated Time of Implement: 24 months*

U.S. EPA estimates that 53,000 yards of contaminated sediment in the Inner Harbor will be dredged so that the Lower River and Inner Harbor surface sediments will achieve a PCB concentration of 0.5 ppm, or less, on average over time. Prior to any dredging, characterization of the Lower River and Inner Harbor will be conducted to delineate PCB concentrations at depth.

Portions of the Lower River may contain contaminated sediment that would impair surface sediments from achieving a 0.5 ppm average over time. Characterization of the sediment will be conducted to determine if any of these contaminated sediment areas currently exist. Contaminated sediment with concentrations greater than 26 ppm within the top 2 feet will be removed. If any of these areas are present, existing data shows that they are likely to be either near the Camp Marina Area, upstream of the Pennsylvania Avenue Bridge or near the island just upstream of the New Jersey Avenue Bridge.

Any dredged sediment in the Lower River and Inner Harbor will be dewatered, stabilized, and disposed of in either a WDNR-approved in-state landfill or out-of-state hazardous waste landfill depending the PCB concentration. Any excavated areas of the Lower River and Inner Harbor will be backfilled with clean sediment in a manner to minimize resuspension or disturbance of contaminated sediments. Annual bathymetric surveys of the Lower River and Inner Harbor will be conducted to assess sediment profile changes and determine if buried PCB-contaminated sediment, equal to or greater than 26 ppm, is vulnerable to disturbance and release.

The Inner Harbor remedy includes characterization and removal of 2 feet of contaminated sediment from the Pennsylvania Avenue Bridge to just past the 8th Street Bridge which is depicted as Area A in Figure 11. Area A is vulnerable to prop wash effects and/or scour. Based on the existing data, PCB concentrations within the top 2 feet of Area A are high enough to keep the Inner Harbor from reaching a PCB SWAC of 0.5 ppm, or less over time. Area A represents about 45 percent of the Inner Harbor and with very little additional deposition likely to occur in this area, the remaining 55 percent of the Inner Harbor would have to reach PCB concentrations near non-detect levels for the entire Inner Harbor to average 0.5 ppm overall.

Figure 11

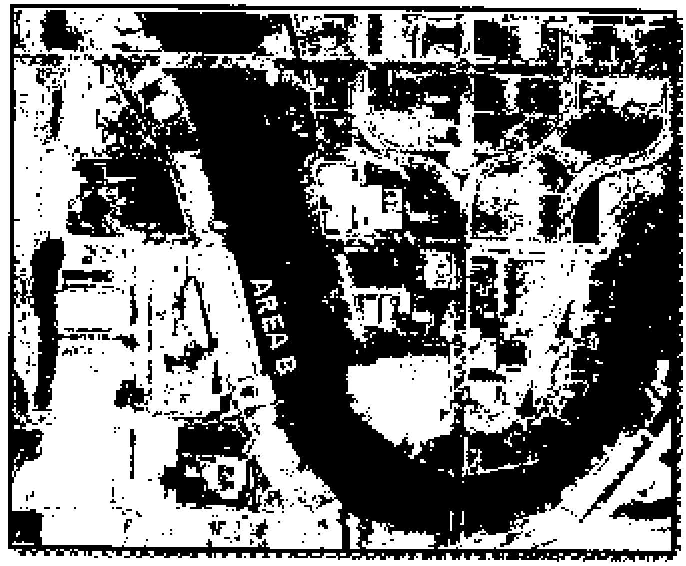

Figure 12

An additional two feet of sediment will be removed in those areas of the Inner Harbor where the bathymetry analysis shows greater than two feet. These areas are noted as Area B in Figure 12 and Area C in Figure 13. Figure 12 also shows what areas of the Inner Harbor that have less than 5 feet of water depth based on the low water datum.

Figure 13

Characterization of PCB contamination may also reveal that areas between the 8th Street Bridge and the Inner Harbor mouth contain PCB concentrations above 26 ppm in areas historically vulnerable scour or within the top foot of the sediment surface. Under these circumstances, contaminated sediment will also be removed between the 8th Street Bridge and the Inner Harbor mouth.

The USACE is authorized to model the fate and transport of sediments for all the Great Lakes Areas of Concern. Modeling for the Sheboygan River is projected to take place prior to implementation of the selected remedy for the Inner Harbor. This modeling is required by Section 516(e) of the Water Resources Development Act of 1996. Data collected during the design phase could be used for this modeling effort. If the modeling results clearly demonstrate increased scour in the Inner Harbor, the remedy will be reevaluated.

Lastly, to keep the most highly contaminated sediment in place, maintenance of the Outer Harbor breakwalls is necessary. Like the other river segments, a long-term monitoring program will be implemented to assess sediment and fish tissue levels over time. If over time it is determined that PCB-contaminated sediment, equal to or greater than 26 ppm, is being exposed or showing up in areas of the Lower River and Inner Harbor that are vulnerable to boat effects and/or scour, these contaminated sediments will be removed and backfilled/covered with clean sediment.

Annual fish sampling will occur until fish consumption advisories are lifted. Sediment samples will be taken at least once every five years to document natural processes and to ensure that over time the entire river will reach an average PCB sediment concentration of 0.5 ppm, or less, and that over time fish consumption advisories will be phased out. Fish and waterfowl consumption advisories will remain in place until monitoring indicates they can be dropped.

Selection of the 26 ppm PCB Trigger

In determining what concentration of PCBs or what mass of PCB would constitute a substantial threat to achieving an overall SWAC of 0.5 ppm for the Lower River and Inner Harbor, U.S. EPA developed a geostatistical sediment sampling design that yielded a specific sampling frequency. U.S. EPA determined that a substantial threat to achieving a 0.5 ppm SWAC, over time, would be the release of PCBs that would recontaminate a surface area representing 20% or more of the Inner Harbor. Since the overall PCB sediment goal is a SWAC of 0.5 ppm, over time, U.S. EPA determined that the release of enough PCBs, over 20% of the harbor, to create an overall Inner Harbor PCB surface sediment concentration of 2.0 ppm in the biologically active zone to be unacceptable. Given the geostatistical sampling approach, mentioned earlier, each sediment sample represents a 8,432 ft^2 area. U.S. EPA has estimated the depth of sediments that can be disturbed by boat traffic or high flow events is approximately 2 feet.

Dividing the calculated mass by the representative volume of each sample, equals a sediment sample concentration of 26 ppm. This means that if a sediment sample is taken and has a PCB concentration of 26 ppm or higher, the 16,864 ft^3 (625 yd^3) volume needs to be addressed for appropriate response action. That could be removal of the 625 yd 3 area or more detailed delineation of the sediment area to determine what volume of the area has PCB concentrations greater than 26 ppm. A more detailed explanation and the actual calculations for the trigger can be found in the Administrative Record.

Floodplain Soil

Based on the U.S. EPA terrestrial assessment and the ecological risks presented in this ROD, the U.S. EPA selects Alternative 4: Removal of Soil Containing PCB concentrations greater than 10 ppm.

Floodplan Selected Remedy: Alternative 4

Estimated Capital Cost: $4.7 million
Annual O & M Cost: $29,800
Duration of O & M: 30 years
Total Present Value (7% discount rate): $4.5 Million
Estimated Time to Implement: 30 months

Floodplain soil containing PCB concentrations greater than 10 ppm will be excavated and disposed of off-site at an approved TSCA landfill. Before initiating excavation, associated access roads and river access will be constructed as necessary.
To further refine the extent of floodplain soil containing PCBs greater than 10 ppm, additional sampling will be performed. Upon completion of the soil removal activities, the affected areas will be restored in an appropriate manner including replacement of the excavated soil, seeding, restoration of any fencing and planting of trees. Any soil/grubbed material will be loaded onto transport trucks and the soil taken off-site for disposal at an approved TSCA facility. If appropriate, cleared material, like trees, will be chipped and used for landscaping mulch. If this is not possible cleared material will be disposed off-site in a local Wisconsin solid waste landfill. The removal of PCB contaminated soil will be balanced with maintaining existing high quality ecological habitat. Lastly, long-term monitoring of the floodplain soil will be conducted.

Ground-water & Additional Source Investigation

Based on information in the Feasibility Study and information presented in this ROD, the U.S. EPA selects Alternative 2: Investigation/Source Identification and Control

Groundwater Selected Remedy: Alternative 2

Estimated Capital Cost: $313,000
Annual O & M Cost: $21,000
Duration of O & M: 30 years
Total Present Value (7% discount rate): $594,000
Estimated Time to Implement: 12 months

Current PCB concentrations in the existing facility monitoring wells will be assessed. If the ground-water sampling determines that PCB are present in ground-water at Tecumseh's Sheboygan Falls plant, additional borings/monitoring wells will be installed to further define the lateral extend of ground-water that contains PCBs and to more closely assess the hydrogeologic parameters at Tecumseh's Sheboygan Falls plant. The hydrogeologic parameters that will be targeted for evaluation include horizontal hydraulic gradient, vertical hydraulic gradient, nature of the ground-water/surface water interaction, including the possible effects of the flood control berm, and temporal variations in ground-water flow direction. The additional borings also will be used to further assess the stratigraphy of the subsurface at Tecumseh's Sheboygan Falls plant. Information necessary to conduct a natural recovery evaluation will be collected.

In conjunction with evaluating ground-water to surface water migration, an investigation will be performed to identify potential PCB sources to ground-water under Tecumseh's Sheboygan Falls plant, or to the Sheboygan River directly. This will include an investigation of existing sewer lines that may be preferential pathways for PCBs into the river. Investigations in 1999 indicated high levels of PCBs in the river bank near Tecumseh's Sheboygan Falls plant. Source removal/control will be required depending on the results of these investigations. Long-term monitoring of Tecumseh's Sheboygan Falls plant ground-water and river bank sampling near Tecumseh's Sheboygan Falls plant will be conducted to ensure that no additional PCB sources to the river exist. If it is determined that ground-water under the Tecumseh plant is venting into surface water, and natural recovery is not appropriate as a final groundwater remedy, or preferential pathways from the Tecumseh plant to the river cannot be removed, Ground-water Alternative 3: Collection Trench and Treatment will be implemented.

Placement of an institutional control to limit access to Tecumseh's Sheboygan Falls plant ground-water as a drinking water source will be implemented.

Summary of the Estimated Remedy Costs

Cost Element	Upper River	Middle River	Lower River & Inner Harbor	Floodplain Soil	Ground-water Investigations/ Source Control
Estimated Capital Cost:	$30,600,000	$0	$12,100,000	$4,700,000	$313,000
Annual O & M Cost:	Varies	Varies	Varies	$29,800	$21,000
Total Present Value (7% discount rate):	$23,800,000	$2,000,000	$10,000,000	$4,500,000	$600,000

Expected Outcomes of Selected Remedy

Removal of PCB-contaminated sediment in the Upper River, Middle River, Lower River and Inner Harbor are expected to achieve a soft sediment SWAC of 0.5 ppm or less upon completion of the remedy or shortly thereafter. Removal of PCB-contaminated floodplain soil will achieve a soil SWAC of 10 ppm or less upon completion of the remedy. Source identification and control or a collection trench and treatment will reduce PCB loading to the Sheboygan River. Implementation of the entire remedy will reduce PCB fish tissue levels such that fish consumption advisories in the river and harbor can be revised. Over the long term, PCB reductions in sediment will reduce chronic and toxic stress on the benthic populations in the river. Reduced sediment toxicity will improve Sheboygan River and Lake Michigan fish spawning conditions. Sediment habitat will be improved such that benthos and wildlife populations will improve, known reproductive impacts on wildlife populations will be diminished.

Dredging in the harbor will significantly reduce resuspension of PCB contaminated sediment from high flow events or boats which will limit the available mass and concentrations of domestic and industrial waste sludges, nutrients, and toxic metals now found in the sediments leading to generally improved conditions in water quality. The selected remedy will reduce PCB loadings to Lake Michigan.

M. <u>STATUTORY DETERMINATIONS</u>

Under CERCLA Section 121 and the NCP, the U.S. EPA must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the selected remedy meets these statutory requirements.

Protection of Human Health and the Environment

Implementation of the selected remedy will adequately protect human health and the environment through the removal and off-site disposal of PCB-contaminated sediment, removal and off-site disposal of PCB-contaminated floodplain soil, and the identification and control of PCB-contaminated ground-water and potential additional PCB sources. The selected remedy will be required to achieve a soft sediment SWAC of 0.5 ppm which equates to a risk of 1.0×10^{-4} for human health and between the NOAEL and LOAEL for the aquatic receptors evaluated. Removal of PCB-contaminated soft sediment will result in an overall river PCB concentration within acceptable risk ranges. While the sediments in the Middle River are not being addressed, this should not impair the entire site from reaching the acceptable risk range. Finally, the selected remedy does not pose unacceptable short-term risk.

Compliance with ARARs

Section 121 (d) of CERCLA requires that Superfund remedial actions meet ARARs. In addition to ARARs, the ARARs analysis which was conducted considered guidelines, criteria, and standards useful in evaluating remedial alternatives. These guidelines, criteria, and standards are known as "To Be Considered" (TBCs). In contrast to ARARs, which are promulgated cleanup standards, standards of control, and other substantive environmental protection requirements, criteria or limitations; TBCs are guidelines and other criteria that have not been promulgated. The selected remedy will comply with the ARARs and the TBCs listed in Table 19.

Potential Chemical-Specific ARARs

Toxic Substances Control Act (TSCA): TSCA establishes requirements for the handling, storage, and disposal of PCB-containing materials in excess of 50 ppm. TSCA is an ARAR at the site with respect to any PCB-containing materials with PCB, concentrations in excess of 50 ppm that are removed from the site. Pursuant to TSCA, the U.S. EPA has promulgated a PCB spill cleanup policy that set forth cleanup criteria for PCB releases that occurred after May 4, 1987. The soil cleanup levels set forth in the policy are 10 ppm for areas of unrestricted access and 25 ppm for locations where access is restricted. The criteria are not directly applicable to the site given the historical nature of the PCB releases in the Sheboygan River (i.e. in the river pre-date the 1987 "cut-off" date). The TSCA PCB spill policy is treated as a TBC for this site as it may provide guidance on addressing soil-related PCB cleanups.

Clean Water Act: Federal surface water quality standards are adopted under Section 304 of the Clean Water Act where a state has not adopted standards. These federal standards, if any, are ARARs for point discharges to the river. Related to these standards are the federal ambient water quality criteria. These criteria are non-enforceable guidelines that identify chemical levels for surface waters and generally may be related to a variety of assumptions such as use of a surface water body as a water supply. These criteria may be TBCs for this site.

Ground-water Quality Standards: State ground-water quality standards for various chemical are set forth in Wisconsin Administrative Code Section NR 140. In general, NR 140.24 and NR 140.26 require preventive action limits (PALs) to be achieved to the extent it is technically and economically feasible to do so. In the remediation context, the environmental standard is to be achieved within a reasonable timeframe. Natural attenuation is allowed as a remedial method where source control activities have been undertaken. The ground-water quality standards constitute an ARAR.

Soil Cleanup Standards: The State of Wisconsin has adopted generic, site-specific, and performance-based soil cleanup standards. These regulations allow the party conducting the remedial action to select which approach to apply. The soil standards are divided into those necessary to protect the ground-water quality and those necessary to prevent unacceptable, direct contact exposure. Generic soil standards, based on conservative default values and assumptions, have been adopted only for a few substances, none of which are relevant to the site. Site-specific soil standards depend upon a variety of factors, including local soil conditions, depth to ground-water, type of chemical, access restrictions, and current and future use of the property. These site-specific soils standards also may be adjusted based on an assessment of the site-specific risk presented by the chemical constituents of concern. With respect to the site, the soil standards constitute an ARAR.

Surface Water Quality Standards: The State of Wisconsin has promulgated water quality standards which are based on two components; 1) use designation for the water body; and 2) water quality criteria. These standards, designations, and criteria are set forth in Wisconsin Administrative Code Sections NR 102 to NR 105. The state also has rules for applying the water quality standards when establishing water-quality-based effluent limits (NR 106, NR 207). The state water quality standards are used in making water management decisions and controlling municipal, business, land development, and agricultural activities (NR 102.04, Wis. Admin. Code). In the remediation context, surface water quality standards are applicable to point source discharges that may be part of the remedial action. Further, to the extent the remedial work is conducted in or near a water body, such work is to be conducted so as to prevent or minimize an exceedance of a water quality criterion (NR 102 to 105).

As recognized in the WDNR's sediment guidance (1995), the water quality standards are goals to be used in guiding the development of the sediment remediation work. As a goal, but not a legal requirement, the water quality standards as applied to the remediation of sediment contamination constitute a TBC.

In addition, the NCP states that, in establishing Remedial Action Objectives (RAOs), water quality criteria established under the Clean Water Act (WQSs in Wisconsin), shall be attained where "relevant and appropriate under the circumstances of the release." 40 C.F.R. Section 300.430(e)(2)(I)(E).

The Agency has determined that WQS's, while relevant to sediment clean up RAOs, are not appropriate for direct application at this time. Calculating a site specific sediment quality standard from a WQS using current scientific methods such as equilibrium partitioning is very uncertain. Moreover, the Agency's 1996 Superfund PCB clean up guidance directly addresses sediment clean up targets using water quality criteria. The guidance suggests using equilibrium partitioning to develop a sediment criteria and then compare it to risk based clean up numbers for establishing an RAO as would be done with a non-ARAR. If the guidance considered a derived sediment quality number to be an ARAR, it would be directly applied to each alternative as a threshold criteria. Therefore, WQSs are not ARARs and are not a threshold criteria for selecting an alternative at the site.

Potential Action- and Location-Specific ARARs

Wisconsin Statutes Chapter 30: Chapter 30 of the Wisconsin Statutes requires permits for work performed in navigable water on or near the bank of such a waterway. Under CERCLA, only the substantive provisions set forth in Chapter 30 (as opposed to the need for a permit) must be satisfied. In general, the substantive provisions address minimizing any adverse effects on the waterway that may result from the work. The substantive provisions are action-specific ARARs.

Section 10 - Rivers and Harbors Act; Section 404 - Clean Water Act: Section 404 of the Clean Water Act requires approval from the USACE for discharges of dredged or fill material into waters of the United States, and Section 10 of the Rivers and Harbors Act requires approval from the USACE for dredging and filling work performed in navigable waters of the United States. As the Sheboygan River is a water of the United States, these statutes might implicate action-specific ARARs for dredging/filling work which may be conducted in the river. Under the Fish and Wildlife Coordination Act, the USACE must coordinate with the Fish and Wildlife Service regarding minimization of effects from such work. The work would be subject to the substantive environmental law aspects of permits under these statutes, which would be ARARs. Permits are not required under CERCLA.

Floodplain and Wetland Regulations and Executive Orders 11988 and 11990: The requirements of 40 C.F.R. § 264.18 (b) and Executive Order 11988, Protection of Flood Plains, are relevant and appropriate to action on the site. Executive Order 11990 (Protection of Wetlands) is an applicable requirement if there are any wetlands present in the areas to be remediated.

National Historic Preservation Action (NHPA), 16 U.S.C. 470 et seq: The National Historic Preservation Act (NHPA) provides protections for historic properties (cultural resources) on or eligible for inclusion on the National Historic Register of Historic Places (see 36 C.F.R. Part 800). In selecting a remedial alternative, adverse effects to such properties are to be avoided. If any portion of the site is on or eligible for the National Historical Register, the NHPA requirements would be ARARs.

Endangered Species: Both State and Federal law have statutory provisions that are intended to protect threatened or endangered species [i.e., Endangered Species Act (Federal) and Fish and Game (State)]. In general, these laws require a determination as to whether any such species (and its related habitat) reside within the area where an activity under review by governmental authority may take place. If the species is present and may be adversely affected by the proposed activity, where the adverse effect cannot be prevented, the proposed action may proceed. If threatened or endangered species exist in certain areas of the Sheboygan River, these laws may constitute an action-specific ARAR. At the site, the queen snake as well as several plant species were noted by WDNR to be endangered/rare resources occurring within or near the site.

Management of PCBs and Products Containing PCBs: Wisconsin regulations [i.e., Management of PCBs and Products Containing PCBs (Wisconsin Administrative Code § NR 157) that were adopted pursuant to section 299.45. Wisconsin Statutes] which establish procedures for the storage, collection, transport, and disposal of PCB containing materials also would apply to remedial actions taken at the site.

Solid Waste Management Statutes and Rules (Chapter 289, Wisconsin Statutes and Wisconsin Administrative Code §§ NR 500-520, Wis. Admin. Code] establish standards that apply to the collection, transportation, storage and disposal of solid waste.

TSCA - Disposal Approval: Under TSCA, U.S. EPA may grant generic approvals for disposal of PCB-containing materials (subject to certain limitations and exceptions). U.S. EPA has granted an approval to Wisconsin allowing the disposal of PCB containing sediments up to 50 ppm PCBs in a state-of-the-art Wisconsin licensed solid waste facility. If PCB-containing sediments are disposed from the site, this U.S. EPA approval would constitute an ARAR with respect to disposal location.

Additional To Be Considered Information

Section 303(d), Clean Water Act: Under Section 303(d) of the Federal Clean Water Act, states are required, on a periodic basis, to submit lists of "impaired waterways" to U.S. EPA. In December 1996, WDNR submitted its first list of impaired waters under Section 303(d). The Sheboygan River was included on the initial list. WDNR has taken no further action with respect to the listing, nor has it developed a total maximum daily load (TMDL) for the river. Currently, a State-wide watershed committee is advising WDNR on the steps to be taken in this process, and the listing process is being reviewed by the Wisconsin Natural Resources Board. The listing of the Sheboygan River under Section 303(d) is a TBC.

Great Lakes Water Quality Initiative, Part 132, Appendix E: The Great Lakes Water Quality Initiative set forth guidance to the states bordering the Great Lakes regarding their wastewater discharge programs. For remedial actions, the guidance states that any remedial action involving discharges should, in general, minimize any lowering of water quality to the extent practicable. The concepts of the guidance have been incorporated into Wisconsin Administrative Code ' NR 102 to ' NR 106. The Great Lakes Water Quality Initiative constitutes a TBC.

Sediment Remediation Implementation Guidance: Part of the Strategic Directions Report of WDNR approved by Secretary Meyer in 1995 addressed the sediment remediation approach to be followed by WDNR. This approach includes meeting water quality standards as a goal of sediment remediation projects. In developing a remedial approach, the guidance calls for use of a complete risk management process in consideration of on-site and off-site environmental effects, technological feasibility, and costs. The guidance constitutes a TBC.

Great Lakes Water Quality Agreement: The Great Lakes Water Quality Agreement calls for the identification of "Areas of Concern" in ports, harbors, and river mouths around the Great Lakes. Remedial goals to improve water quality are to be established in conjunction with the local community. In Sheboygan, a Remedial Action Plan (RAP) was prepared and finalized in 1995. The RAP lists a series of recommendations ranging from addressing contaminated sediments to controlling non-point source runoff. This is a TBC.

Sheboygan River Basin Water Quality Management Plan: This plan was developed by WDNR and lists management objectives for improving water quality in the Sheboygan River Basin. This is a TBC.

Table 18 - Sheboygan River and Harbor ARARs	
Act / Regulation	Citation
Federal Chemical-Specific ARARs	
TSCA	40 CFR 761.60(a)(5)-761.79 and U.S. EPA Disposal Approval
Clean Water Act - Federal Water Quality Standards	40 CFR 131 (if no Wisconsin regulation) and 33 CFR 323
Federal Action-/Location - Specific ARARs	
Fish and Wildlife Coordination Act	16 USC 661 *et seq*. 33 CFR 320-330-Rivers and Harbors Act 40 CFR 6.304
Endangered Species Act	16 USC 1531 *et seq.* 50 CFR 200 50 CFR 402
Rivers and Harbor Act	33 USC 403; 33 CFR 322, 323
National Historic Preservation Act	15 USC 470; et seq. 36 CFR Part 800
Floodplain and Wetlands Regs & Executive Orders	40 CFR 264.18 (b) and Executive Order 11988
State Chemical-Specific ARARs	
TSCA-Disposal Approval	U.S. EPA Approval
Surface Water Quality Standards	NR 106 and 207 NR 722.09 1-2
Ground-Water Quality Standards	NR 140
Soil Cleanup Standards	NR 720 and 722
Hazardous Waste Statutes and Rules	NR 500 - 520
State Action- / Location-Specific ARARs	
Management of PCBs and Products Containing PCBs	NR 157
Solid Waste Management	NR 500-520
Navigable Waters, Harbors, and Navigation	Chapter 30 - Wisconsin Statues
Fish and Game	Chapter 29.415 - Wisconsin Statutes

Cost-Effectiveness

U.S. EPA has determined that the selected remedy is cost effective. Section 300.430 (f)(1)(ii)(D) of the NCP requires U.S. EPA to evaluate cost effectiveness by comparing all the alternatives that meet the threshold criteria (protection of human health and the environment and compliance with ARARs) against three balancing criteria (long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, and short-term effectiveness). The selected remedies meet these criteria by achieving a permanent protection of human health and the environment at low risk to the public, and provide for overall effectiveness in proportion to their cost.

The Superfund program does not mandate the selection of the most cost effective cleanup alternative. The most cost effective remedy is not necessarily the remedy that provides the best balance of tradeoffs with respect to the remedy selection criteria nor is it necessarily the least-costly alternative that is both protective of human health and the environment and ARAR-compliant. Cost effectiveness is concerned with the reasonableness of the relationship between the effectiveness afforded by each alternative and its costs compared to other available options.

The total net present worth of the selected remedy is $40,900,000. Although Upper River alternative 3-II and Floodplain Soil alternative 2, the PRP preferred alternatives, are less expensive than the U.S. EPA selected alternatives, 3-IV-A and 4 respectively, the additional mass removed under the selected remedy provides a significant increase in overall protection of human health and the environment to meet the threshold risk target range and is cost effective. In addition, while the PRP preferred alternative for the Lower River and Harbor, alternative 2, is less expensive than the U.S. EPA alternative, alternative 4, the U.S. EPA alternative will remove the PCB-contaminated sediments most vulnerable to resuspension due to recreational uses and high river flow events. Continued maintenance of the Inner Harbor breakwalls will effectively contain the more highly PCB-contaminated sediments buried at depth that are not vulnerable to human or natural disturbances.

Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

U.S. EPA believes that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the Sheboygan River and Harbor site. The selected remedy does not pose excessive short-term risks. There are no special implementability issues that set the selected remedy apart from the other alternatives evaluated.

Preference for Treatment as a Principal Element

Based on current information, U.S. EPA believes that the selected remedy is protective of human health and the environment and utilizes permanent solutions to the maximum extent possible. The remedy, however, does not satisfy the statutory preference for treatment of the hazardous substances present at the site as a principal element because such treatment was not found to be practical or cost effective.

Five-year Review Requirements

The NCP, at 40 C.F.R. § 300.430(f)(4)(ii), requires a five-year review if the remedial action results in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. Because this remedy will result in hazardous contaminants remaining on-site above levels that allow for unlimited exposure, a statutory review will be conducted within five years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

N. DOCUMENTATION OF SIGNIFICANT CHANGES FROM PREFERRED ALTERNATIVE OF PROPOSED PLAN

To fulfill CERCLA 117(b) and NCP [40 C.F.R. ' ' 300.430(f)(5)(iii)(B) and 300.430(f)(3)(ii)(A)], the ROD must document and discuss the reasons for any significant changes made to the Selected Remedy.

The Proposed Plan was released for public comment in May 1999. It identified a PCB sediment clean up target of 1.0 ppm and Lower River and Inner Harbor Alternative 5, Inner Harbor Sediment Removal - Safe Navigational Depth as the Preferred Alternative for the sediment remediation in the Lower River and Inner Harbor.

The Proposed Plan recommendation of the 1.0 ppm target was selected based on use of the RME for human health risks and meeting the NOAEL to LOAEL range for ecological receptors evaluated. The selected soft sediment cleanup target of 0.5 ppm is based on the same overall human health and ecological risk exposure assumptions. However, two adjustments were made were made to the calculation for human health risk under the RME exposure scenario. The first adjustment was required as a result of a mistyped equation. The second adjustment was made as a result of an improved lipid figure in the derivation of the appropriate PCB concentration in small mouth bass. These adjustment require the selection of 0.5 ppm, as the soft sediment cleanup target, to meet a human health risk of 1.0×10^{-4}. The 0.5 ppm sediment target remains within the NOAEL to LOAEL range for fauna evaluated.

Under the recommended alternative for the Lower River and Inner Harbor, in the Proposed Plan, approximately 100,000 cubic yards of contaminated sediment between the Pennsylvania Avenue Bridge and the Inner Harbor mouth would be dredged. The removal of these sediment would create a 10 to 12 foot channel for recreational boats to travel in without disturbing contaminated sediments from prop wash or keel grounding. The estimated cost of this alternative was $26,900,000.

The remedy was preferred over the other possible Lower River and Inner Harbor alternatives because it provided the best overall balance of nine criteria based on the information available at the time. Removing contaminated sediments that were going to be disturbed by boat traffic would allow surficial sediments in the Inner Harbor to reach the PCB sediment goal.

This depth was determined based on information obtained from the City of Sheboygan and the U.S. Coast Guard through NOAA. According to the City of Sheboygan, the largest recreational vessels using the Inner Harbor required a water depth of 10 feet. In addition, the U.S. Coast Guard recommended a 2 foot buffer between the maximum depth necessary and harbor bottom for safe navigational purposes. Dredging to a depth of 12 feet exposes more highly contaminated sediments. Therefore, to allow for a 12 foot water depth and not expose highly contaminated sediments, the channel would be over-dredged an additional 2 feet and backfilled with 2 feet of clean sediment. This would create a 2 foot buffer between the contaminated sediment and the maximum water depth necessary. This 2 foot buffer would also allow for future maintenance dredging for safe navigation without disturbing PCB-contaminated sediments.

During the public comment period additional information obtained from the City of Sheboygan and comments submitted by the PRPs initiated a reevaluation of the depth and dredging boundaries of the proposed alternative. In addition, during the public comment period, the U.S. EPA National Remedy Review Board (NRRB) evaluated and submitted comments on the Inner Harbor preferred alternative.

<u>New Information obtained from the City of Sheboygan During the Public Comment Period</u>

Based on new and more detailed information nearly all of the motor and sailboats require only 7 feet of water depth. Only a small percentage of the largest sailboats need more than 7 feet of water. The frequency that these larger sail boats would significantly disturb contaminated sediments at depth is much less than previously anticipated.

<u>Information submitted from Tecumseh Products Company During the Public Comment Period</u>

According to a prop wash analysis submitted during the public comment period the top foot of sediment is potentially disturbed by motorboats. This analysis was reviewed by the USACE, which concurred with the general conclusions. One underlying assumption of the prop wash analysis was a minimum water depth of 5 feet. Areas of the Inner Harbor near the Pennsylvania Avenue Bridge routinely have less than 5 feet of water, which would mean that sediment in these areas may see prop wash effects beyond the top foot. The prop wash analysis also noted that the effects of high flow events are more likely to disturb surface sediment, than prop wash effects. The USACE concurred with this assessment.

Based on the concern that high flow events would disturb sediment at greater depths than recreational boats, a bathymetric analysis was performed. Bathymetrys dating back to 1979 were reviewed to determine if the Inner Harbor is primarily depositional in nature and to see what effects, if any, a number of high flow events within the last few years have had on the sediment surface of the Inner Harbor. As previously noted, the area of the Inner Harbor, between the 8th Street Bridge and Inner Harbor mouth is primarily depositional in nature. However, Areas B and C in Figures 16 and 17 have shown significant scour since 1991. Based on a review of harbor bathymetrys, very little additional sediment is expected to be deposited between the Pennsylvania and 8 th Street Bridges.

The bathymetric analysis all of the Inner Harbor sediment data was “repositioned” to account for deposition and scour which occurred between the year the data was collected and 1999. An extrapolation of PCB concentrations using Earth Vision software, shows that high levels of PCB concentration are near the surface between the Pennsylvania Avenue and 8th Street Bridges. Water depths between the Pennsylvania Avenue and 8th Street Bridges range from 1 foot to 18 feet. However water depths greater than 8 feet occur just west of the 8th Street Bridge. Conversely, PCB concentrations near the surface between the 8 1h Street Bridge and harbor mouth are lower and water depths are generally deeper than 9 feet and go as deep at 17 feet. These factors have result in an Inner Harbor remedy that focuses on the removal of contaminated sediment from the Pennsylvania Avenue Bridge to just past the 8th Street Bridge. This is shown in Area A in Figure 15.

<u>Comments submitted by the NRRB</u>

On July 28, 1999, the National Remedy Review Board reviewed the U.S. EPA’s Proposed Plan preferred alternative for the Lower River and Inner Harbor. The NRRB comments focused on the following points.

- The board recommended that Region V conduct an analysis that shows how the sediment disturbances would result in unacceptable risks. In particular, the region should describe how the preferred alternative (dredging a deep channel from the harbor to the bridges in zones A, B, C, and D, but taking no action near shore) adequately reduces risk.

- Because the boat traffic in the Inner Harbor could redistribute contaminated sediment, the region proposes to dredge a narrow channel and use institutional controls to prevent boaters from disturbing sediment in other parts of the river. The board recommended that the region also consider alternatives that provide greater reliability over time and that require less care to maintain. For example, the region might consider shallower, but shore-to-shore dredging in all (or

> selected) areas to permit full use of the river by the vast majority of boaters. In addition, the region should consider an alternative that focuses on “hot spot” removal, which may also reduce overall contaminant remobilization predicted to occur from future navigational dredging actions.

The selected remedy for the Lower River and Inner Harbor recognizes the new information submitted during the public comment period and addresses the comments submitted by the NRRB. The Inner Harbor remedy has changed from a narrower and deeper dredging approach to a shallower shore-to-shore dredging approach. Because the Sheboygan River is a public waterway, institutional controls to limit boat traffic to the deeper channel or less contaminated areas will be ineffective. Even if possible, any limits placed on the use of the Inner Harbor would be contrary to reuse initiatives within the Superfund program. Therefore, the approach to dredging in the Inner Harbor of shore-to-shore of PCB contamination is not limited to any particular location. Based on the information obtained from the City of Sheboygan marina, over 95 percent of the recreational boats using the Inner Harbor require only 7 feet of water depth. Most of the Inner Harbor from the 8th Street Bridge to the harbor mouth has 7 feet of water or more. Therefore, recreational impacts are limited to within the top one foot of the sediment bed based on the prop wash analysis. However, most of the Inner Harbor between the Pennsylvania Avenue and 8th Street Bridges does not have very deep water. The U.S. EPA has selected shore-to-shore dredging of 2 feet, and backfilling to create a buffer between the prop wash disturbance “zone” and the more contaminated sediment below.

Areas B and C will be dredged an additional 2 feet and backfilled to remove PCB contaminated sediments that are vulnerable to scour beyond the top 2 feet. These scour areas are based on a review of Inner Harbor bathymetry from 1979 to 1999. Consistent with the NRRB’s “hot spot” recommendation, any additional sediments just below the planned excavation depths equal to or greater than 26 ppm will be removed. The selected alternative calls for removal of approximately 53,000 cubic yards at a net present worth cost of approximately $10,000,000, including long-term monitoring, continued bathymetry analyses and maintenance of the breakwalls.

Lastly, the estimated remedy costs have come down since the Proposed Plan was issued. The cost reduction is due to less sediment being removed than called for in the Inner Harbor and because a different discount rate is being used for calculating the net present worth of all of the alternatives. The Feasibility Study assumed a discount factor of 5%. Now, consistent with Superfund guidance, a discount factor of 7% is used. This means that work that stretches over a number of years, like the Upper River dredging, or work that isn’t going to be initiated for a few years, like the Inner Harbor dredging, can have a total present net worth less than the calculated capital and annual O&M costs.

The estimated cost of the Upper River remedy has gone from $31.4 million to $23.8 million. The cost of the Lower River and Inner Harbor remedy has gone from $26.9

million to $10.0 million. Costs associated with the Floodplain Soil has only a slight reduction in cost. Costs associated with the Middle River and Groundwater are similar to the Proposed Plan costs.

SHEBOYGAN RIVER AND HARBOR
FEASIBILITY STUDY REPORT

UPPER RIVER SEDIMENT- NATURAL RECOVERY

Mechanical Removal and Disposal of CTF/SMF Sediment and Long-Term Monitoring

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT PRICE	ESTIMATED COST
1	Mobilization/Demobilization	1	L.S.	5%	$23,000
2	Mechanically Remove Sediment from CTF/SMF	4,300	CY	$40	$172,000
3	Stabilization of All Sediment -System Rental/Operations (excludes labor) -Materials (i.e., S/S Agent)	1 1,400	L.S. TON	$157,000 $20	$157,000 $28,000
4	Labor Support to Operate and Maintain Dewatering Operations and the Water Treatment System at the CTF	1.5	MO	$30,000	$45,000
5	Load Dewatered Sediment into Transport Trucks	4,900	CY	$10	$49,000
6	Decommission/Dismantle CTF and SMF	1	L.S.	$650,000	$650,000
7	Truck Scale Rental	1.5	MO	$4,500	$6,750
8	Transport and Dispose Dewatered Sediment at a TSCA Permitted Facility	8,800	TON	$140	$1,232,000
	SUBTOTAL=				$2,362,750
9	Engineering/Design	10%			$48,075
10	Construction Management	1.5	MO	$15,000	$22,500
11	Contingency	25%			$120,188
	TOTAL CAPITAL COSTS =				$2,553,513
12	30-Year Monitoring (Present Worth)				$1,987,789
	TOTAL ALTERNATIVE =				$4,541,302

Cost Tables

Summary of Present Worth Analysis Upper River Sediment Removal Alternative 3-V						
		Annual O&M Cost			Discount	Present
Year	Capital Cost	Fish Monitoring	Sediment Monitoring	Total Cost	Factor (7%)	Worth
0		$140,000		$140,000	1.000	$140,000
1		$140,000		$140,000	0.935	$130,841
2	$4,580,501	$140,000		$4,720,501	0.873	$4,123,068
3	$4,580,501	$140,000		$4,720,501	0.816	$3,853,335
4	$4,580,501	$140,000		$4,720,501	0.763	$3,601,247
5	$4,580,501	$140,000		$4,720,501	0.713	$3,365,652
6	$4,580,501	$140,000		$4,720,501	0.666	$3,145,469
7	$4,580,501	$140,000		$4,720,501	0.623	$2,939,691
8	$4,580,501	$140,000		$4,720,501	0.582	$2,747,374
9	$1,017,889	$140,000	$35,000	$1,192,889	0.544	$648,853
10		$140,000		$140,000	0.508	$71,1699
11		$140,000		$140,000	0.475	$66,513
12		$140,000		$140,000	0.444	$62,162
13		$140,000		$140,000	0.415	$58,095
14		$140,000	$35,000	$175,000	0.388	$67,868
15		$140,000		$140,000	0.362	$50,742
16		$140,000		$140,000	0.339	$47,423
17		$140,000		$140,000	0.317	$44,320
18		$140,000		$140,000	0.296	$41,421
19		$140,000	$35,000	$175,000	0.277	$48,389
20		$140,000		$140,000	0.258	$36,179
21		$140,000		$140,000	0.242	$33,812
22		$140,000		$140,000	0.226	$31,600
23		$140,000		$140,000	0.211	$29,533
24		$140,000	$35,000	$175,000	0.197	$34,501
25		$140,000		$140,000	0.184	$25,795
26		$140,000		$140,000	0.172	$24,107
27		$140,000		$140,000	0161	$22,530
28		$140,000		$140,000	0.150	$21,056
29		$140,000	$35,000	$175,000	0.141	$24,598
30		$140,000		$140,000	0.131	$18,391
Totals	$33,081,394	$4,340,000	$175,000	$37,596,394		**$25,555,734**

Assumptions: Construction expected 9 out of 12 months each year.
Captial Costs Obtained from Feasibility Study and Timephase Based on Project Duration - 65 months

SHEBOYGAN RIVER & HARBOR SUPERFUND SITE
MIDDLE RIVER - MONITORED NATURAL PROCESSES

SUMMARY OF CAPITAL and O&M COSTS

Alternative: **2**
Description: **No Access Areas**
SWAC of 1.5 ppm
Site: Sheboygan River & Harbor
Location: Sheboygan, WI
Date Prepared: 03/23/2000

Expected Accuracy Range: FS: -30%/+50%
Present Net Worth Discount Rate: 7.0%
Base Year of Estimate: 2000
Capital Cost Years: N/A
O&M Cost Years: 1 - 30

	Description	Quantity	Unit	Unit Cost	Cost	Totals	Notes
	Capital Cost (Year 1998)						
1	Mobilization / Demobilization	0	Lump Sum	5.0%	$0	$0	
2	Monitor, Samp. Test, & Analy.						
	Monitoring During Dredging	0	Cubic Yards	$125.00	$0	$0	
3	Site Work						
	Access Area Development	0	Sq. Ft.	$4.40	$0	$0	
4	Excavation / Collection / Extraction					$0	
	Prepare/Perform Dredging	0	Cubic Yards	$450.00	$0		
	Transport Sediment to CTF	0	Cubic Yards	$110.00	$0		
	Labor	0	Months	$30,000.00	$0		
	Load Stabilized Sediment	0	Cubic Yards	$10.00	$0		
5	Containment / Control						
6	On-Site Treatment					$0	
	Stabilization - System Purchase	0	Lump Sum	$850,000.00	$0		
	Stabilization - Sediment	0	TON	$20.00	$0		
7	Off-Site Treatment / Disposal					$0	
	Transport & Dispose In-State	0	Tons	$40.00	$0		sediments < 50 ppm
	Transport & Dispose Out-of-State	0	Tons	$140.00	$0		sediments > 50 ppm
8	Site Controls						
9	Institutional Controls						
	SUBTOTAL					$0	
10	Contingency			10.0%	$0	$0	
	SUBTOTAL					$0	
11	Project Management & Support						
	Engineering / Design			10.0%	$0		
	Construction Management	0	Months	$37,000.00	$0	$0	
	TOTAL CAPITAL COSTS					$0	
	O&M Costs *				$4,550,000	$4,550,000	
	TOTAL CAPITAL & O&M COSTS					**$4,550,000**	
	NET PRESENT WORTH OF CAPITAL & O&O COSTS					**$1,969,785**	

Assumptions:

Schedule Estimate (0 months)

* O&M Costs - assumed long-term fish and sediment monitoring over a 30-year period. Fish monitoring annually, sediment sampling every 5 years. Fish monitoring - $140,000 with an additional $35,000 every 5th for sediment monitoring. Present worth calculated assuming an initial cash outlay and using a discount rate of 7%, over the 30-year period as suggested by US EPA's Draft Remedy Cost Estimating Procedures Manual.

SHEBOYGAN RIVER & HARBOR SUPERFUND SITE
UPPER RIVER - SWAC TO 1.5 ppm, THEN MASS REDUCTION APPROACH

SUMMARY OF CAPITAL and O&M COSTS

Alternative: **3-IV-A**
Description: **Sediment in Access Areas 123, 4 5, 6, 7**
SWAC of 0.5 ppm, PCB Mass Red of 88.9%
Site: Sheboygan River & Harbor
Location: Sheboygan, WI
Date Prepared: 05/02/2000

Expected Accuracy Range:	FS: -30%/+50%
Present Net Worth Discount Rate:	7.0%
Base Year of Estimate:	2000
Capital Cost Years:	2 - 8
O&M Cost Years:	1 - 30

	Description	Quantity	Unit	Unit Cost	Cost	Totals	Notes
	Capital Cost (Year 2000)						
1	Mobilization / Demobilization	1	Lump Sum	5.0%	$932,823	$932,823	
2	Monitor, Samp. Test, & Analy.						
	Monitoring During Dredging	20,774	Cubic Yards	$125.00	$2,596,750	$2,596,750	
3	Site Work	25,000	Sq. Ft.	$4.40	$990,000	$990,000	
	Access Area Development						
	(Access Areas 123,4,5,6,7)						
4	Excavation / Collection / Extraction					$14,663,135	
	Prepare/Perform Dredging	20,774	Cubic Yards	$450.00	$9,348,300		
	Transport Sediment to CTF	20,774	Cubic Yards	$110.00	$2,285,140		
	Labor	60	Months	$30,000.00	$1,800,000		
	Load Stabilized Sediment	32,470	Cubic Yards	$10.00	$324,695		
	CTF Liner Replace. & Main.	1	Lump Sum	$225,000.00	$225,000		
	Decommission/Dismantle CTF/ SMP	1	Lump Sum	$650,000.00	$650,000		
	Portable Truck Purchase	1	Lump Sum	$30,000.00	$30,000		
5	Containment / Control						
6	On-Site Treatment					$1,056,577	
	Stabilization - System Purchase	1	Lump Sum	$850,000.00	$850,000		
	Stabilization - Sediment	10,329	TON	$20.00	$206,577		
7	Off-Site Treatment / Disposal					$3,422,970	
	Transport & Dispose In-State	34,230	Tons	$40.00	$1,369,188		sediments < 50 ppm
	Transport & Dispose Out-of-State	14,670	Tons	$140.00	$2,053,782		sediments > 50 ppm
8	Site Controls						
9	Institutional Controls						
	SUBTOTAL					$23,662,255	
10	Contingency			10.0%	$2,366,226	$2,366,226	
	SUBTOTAL					$26,028,481	
11	Project Management & Support					$4,586,226	
	Engineering / Design			10.0%	$2,366,226		
	Construction Management	60	Months	$37,000.00	$2,220,000		
	TOTAL CAPITAL COSTS					$30,614,706	
	O&M Costs *				$4,515,000	$4,515,000	
	TOTAL CAPITAL & O&M COSTS					**$35,129,706**	
	NET PRESENT WORTH OF CAPITAL & O&M COSTS					**$23,821,259**	

Assumptions:
Unit Costs derived from PRP FS: access development, dredging, monitoring, stabilization and labor from site's previous removal activity costs, truck purchase - Means (108-801-4200), transportation and disposal based on quotes [EQ Landfill, MI], other costs based on PRP consultant estimates.

Schedule Estimate (60 months) based on FS estimate of 26 months for 8860 cy, 20774/8860 = 2.3, 26 x 2.3 = 60

* O&M Costs - assumed long-term fish and sediment monitoring over a 30-year period. Fish monitoring annually, sediment sampling every 5 years. Fish monitoring - $140,000 with an additional $35,000 every 5th for sediment monitoring. Present worth calculated assuming an initial cash outlay and using a discount rate of 7%, over the 30-year period as suggested by US EPA’s Draft Remedy Cost Estimating Procedures Manual.

Summary of Present Worth Analysis
Upper River Sediment Removal Alternative 3-IV

Year	Capital Cost	Annual O&M Cost Fish Monitoring	Annual O&M Cost Sediment Monitoring	Total Cost	Discount Factor (7%)	Present Worth
0		$140,000		$140,000	1.000	$140,000
1		$140,000		$140,000	0.935	$130,841
2	$4,756,244	$140,000		$4,896,244	0.873	$4,276,569
3	$4,756,244	$140,000		$4,896,244	0.816	$3,996,794
4	$4,756,244	$140,000		$4,896,244	0.763	$3,735,321
5	$4,756,244	$140,000		$4,896,244	0.713	$3,490,954
6	$3,170,829	$140,000	$35,000	$3,345,829	0.666	$2,229,467
7		$140,000		$140,000	0.623	$87,185
8		$140,000		$140,000	0.582	$81,481
9		$140,000		$140,000	0.544	$76,151
10		$140,000		$140,000	0.508	$71,169
11		$140,000	$35,000	$175,000	0.475	$83,141
12		$140,000		$140,000	0.444	$62,162
13		$140,000		$140,000	0.415	$58,095
14		$140,000		$140,000	0.388	$54,294
15		$140,000		$140,000	0.362	$50,742
16		$140,000	$35,000	$175,000	0.339	$59,279
17		$140,000		$140,000	0.317	$44,320
18		$140,000		$140,000	0.296	$41,421
19		$140,000		$140,000	0.277	$38,711
20		$140,000		$140,000	0.258	$36,179
21		$140,000	$35,000	$175,000	0.242	$42,265
22		$140,000		$140,000	0.226	$31,600
23		$140,000		$140,000	0.211	$29,533
24		$140,000		$140,000	0.197	$27,601
25		$140,000		$140,000	0.184	$25,795
26		$140,000	$35,000	$175,000	0.172	$30,134
27		$140,000		$140,000	0161	$22,530
28		$140,000		$140,000	0.150	$21,056
29		$140,000		$140,000	0.141	$19,679
30		$140,000		$140,000	0.131	$18,391
Totals	$22,195,805	$4,340,000	$175,000	$26,710,805		**$19,112,860**

Assumptions: Construction expected 9 out of 12 months each year.
Captial Costs Obtained from Feasibility Study and Timephase Based on Project Duration - 40 months

SHEBOYGAN RIVER & HARBOR SUPERFUND SITE
UPPER RIVER - PRP FS ASSUMPTIONS

SUMMARY OF CAPITAL and O&M COSTS

Alternative: 3-V		Expected Accuracy Range:	FS: -30%/+50%
Description: Sediment in Access Areas 123, 4 5, 6, 7, 8		Present Net Worth Discount Rate:	7.0%
SWAC of 0.4 ppm, PCB Mass Red of 90%		Base Year of Estimate:	2000
Site: Sheboygan River & Harbor		Capital Cost Years:	2 - 8
Location: Sheboygan, WI		O&M Cost Years:	1 - 30
Date Prepared: 04/07/2000			

	Description	Quantity	Unit	Unit Cost	Cost	Totals	Notes
	Capital Cost (Year 2000)						
1	Mobilization / Demobilization	1	Lump Sum	5.0%	$1,011,567	$1,011,567	
2	Monitor, Samp. Test, & Analy.						
	Monitoring During Dredging	22,524	Cubic Yards	$125.00	$2,815,500	$2,815,500	
3	Site Work						
	Access Area Development	250,000	Sq. Ft.	$4.40	$1,100,000	$1,100,000	
4	Excavation / Collection / Extraction					$15,891,865	
	Prepare/Perform Dredging	22,524	Cubic Yards	$450.00	$10,135,800		
	Transport Sediment to CTF	22,524	Cubic Yards	$110.00	$2,477,640		
	Labor	65	Months	$30,000.00	$1,950,000		
	Load Stabilized Sediment	34,843	Cubic Yards	$10.00	$348,425		
	CTF Liner Replace. & Main.	1	Lump Sum	$3000,000.00	$300,000		
	Decommission/Dismantle CTF/	1	Lump Sum	$650,000.00	$650,000		
	SMP	1	Lump Sum	$30,000.00	$30,000		
	Portable truck Purchase						
5	Containment / Control						
6	On-Site Treatment					$1,073,979	
	Stabilization - System Purchase	1	Lump Sum	$850,000.00	$850,000		
	Stabilization - Sediment	11,199	TON	$20.00	$223,979		
7	Off-Site Treatment / Disposal					$3,670,751	
	Transport & Dispose In-State	36,708	Tons	$40.00	$1,468,300		sediments < 50 ppm
	Transport & Dispose Out-of-State	15,732	Tons	$140.00	$2,202,450		sediments > 50 ppm
8	Site Controls						
9	Institutional Controls						
	SUBTOTAL					$25,563,662	
10	Contingency			10.0%	$2,556,366	$2,556,366	
	SUBTOTAL					$28,120,028	
11	Project Management & Support					$4,961,366	
	Engineering / Design			10.0%	$2,556,366		
	Construction Management	65	Months	$37,000.00	$2,405,000		
	TOTAL CAPITAL COSTS					$33,081,394	
	O&M Costs *				$4,515,000	$4,515,000	
	TOTAL CAPITAL & O&M COSTS					**$37,596,394**	
	NET PRESENT WORTH OF CAPITAL & O&M COSTS					**$25,555,734**	

Assumptions:
Unit Costs derived from PRP FS: access development, dredging, monitoring, stabilization and labor from site's previous removal activity costs, truck purchase - Means (108-801-4200), transportation and disposal based on quotes [EQ Landfill, MI], other costs based on PRP consultant estimates.

Schedule Estimate (65 months) based on FS estimate of 26 months for 8860 cy, 22524/8860 = 2.5, 26 x 2.3 = 65

* O&M Costs - assumed long-term fish and sediment monitoring over a 30-year period. Fish monitoring annually, sediment sampling every 5 years. Fish monitoring - $140,000 with an additional $35,000 every 5th for sediment monitoring. Present worth calculated assuming an initial cash outlay and using a discount rate of 7%, over the 30-year period as suggested by US EPA's Draft Remedy Cost Estimating Procedures Manual.

Summary of Present Worth Analysis

Upper River Sediment Removal Alternative 3-IV-A (PCB) SWAC to 1.5 ppm then Mass Reduction)

Year	Capital Cost	Annual O&M Cost Fish Monitoring	Annual O&M Cost Sediment Monitoring	Total Cost	Discount Factor (7%)	Present Worth
0		$140,000		$140,000	1.000	$140,000
1		$140,000		$140,000	0.935	$130,841
2	$4,592,206	$140,000		$4,732,206	0.873	$4,133,292
3	$4,592,206	$140,000		$4,732,206	0.816	$3,862,890
4	$4,592,206	$140,000		$4,732,206	0.763	$3,610,177
5	$4,592,206	$140,000		$4,732,206	0.713	$3,373,997
6	$4,592,206	$140,000		$4,732,206	0.666	$3,153,269
7	$4,592,206	$140,000		$4,732,206	0.623	$2,946,980
8	$3,061,471	$140,000	$35,000	$3,236,471	0.582	$1,883,655
9		$140,000		$140,000	0.544	$76,151
10		$140,000		$140,000	0.508	$71,169
11		$140,000		$140,000	0.475	$66,513
12		$140,000		$140,000	0.444	$62,162
13		$140,000	$35,000	$175,000	0.415	$72,619
14		$140,000		$140,000	0.388	$54,294
15		$140,000		$140,000	0.362	$50,742
16		$140,000		$140,000	0.339	$47,423
17		$140,000		$140,000	0.317	$44,320
18		$140,000	$35,000	$175,000	0.296	$51,776
19		$140,000		$140,000	0.277	$38,711
20		$140,000		$140,000	0.258	$36,179
21		$140,000		$140,000	0.242	$33,812
22		$140,000		$140,000	0.226	$31,600
23		$140,000	$35,000	$175,000	0.211	$36,916
24		$140,000		$140,000	0.197	$27,601
25		$140,000		$140,000	0.184	$25,795
26		$140,000		$140,000	0.172	$24,107
27		$140,000		$140,000	0161	$22,530
28		$140,000		$140,000	0.150	$21,056
29		$140,000	$35,000	$175,000	0.141	$24,598
30		$140,000		$140,000	0.131	$18,391
Totals	$30,614,706	$4,340,000	$175,000	$35,129,706		**$24,173,567**

Assumptions: Construction expected 9 out of 12 months each year.
Captial Costs Obtained from Feasibility Study and Timephase Based on Project Duration - 60 months

SHEBOYGAN RIVER & HARBOR SUPERFUND SITE
UPPER RIVER - PRP FS ASSUMPTIONS

SUMMARY OF CAPITAL and O&M COSTS

Alternative: **3-I**
Description: **Sediment in Access Areas 5 and 7**
SWAC of 2.9 ppm, PCB Mass Red of 34%
Site: Sheboygan River & Harbor
Location: Sheboygan, WI
Date Prepared: 04/07/2000

Expected Accuracy Range: FS: -30%/+50%
Present Net Worth Discount Rate: 7.0%
Base Year of Estimate: 1998
Capital Cost Years: 2 - 4
O&M Cost Years: 1 - 30

	Description	Quantity	Unit	Unit Cost	Cost	Totals	Notes
	Capital Cost (Year 1998)						
1	Mobilization / Demobilization	1	Lump Sum	5.0%	$282,279	$282,279	
2	Monitor, Samp, Test, & Analy.	5,360	Cubic Yards	$125.00	$670,00	$670,00	
	Monitoring During Dredging						
3	Site Work						
	Access Area Development	50,000	Sq. Ft.	$4.40	$220,000	$220,000	
4	Excavation / Collection / Extraction					$4,502,282	
	Prepare/Perform Dredging	5,360	Cubic Yards	$450.00	$2,412,000		
	Transport Sediment to CTF	5,360	Cubic Yards	$110.00	$589,600		
	Labor	16	Months	$30,000.00	$480,000		
	Load Stabilized Sediment	11,568	Cubic Yards	$10.00	$115,682		
	CTF Liner Replace. & Main.	1	Lump Sum	$225,000.00	$225,000		
	Decommission/Dismantle CTF/	1	Lump Sum	$650,000.00	$650,000		
	SMP	1	Lump Sum	$30,000.00	$30,000		
	Portable Truck Purchase						
5	Containment / Control						
6	On-Site Treatment					$903,300	
	Stabilization - System Purchase	1	Lump Sum	$850,000.00	$850,000		
	Stabilization - Sediment	2,665	TON	$20.00	$53,300		
7	Off-Site Treatment / Disposal					$1,860,776	
	Transport & Dispose In-State	6,203	Tons	$40.00	$248,103		sediments < 50 ppm
	Transport & Dispose Out-of-State	11,519	Tons	$140.00	$1,612,672		sediments > 50 ppm
8	Site Controls						
9	Institutional Controls						
	SUBTOTAL					$8,438,636	
10	Contingency			10.0%	$843,864	$843,864	
	SUBTOTAL					$9,282,500	
11	Project Management & Support					$1,435,864	
	Engineering / Design			10.0%	$843,864		
	Construction Management	16	Months	$37,000.00	$592,000		
	TOTAL CAPITAL COSTS					$10,718,363	
	O&M Costs *				$4,550,000	$4,550,000	
	TOTAL CAPITAL & O&M COSTS					**$15,268,363**	
	NET PRESENT WORTH OF CAPITAL & O&M COSTS					**$11,057,616**	

Assumptions: Unit Costs derived from PRP FS: access development, dredging, monitoring, stabilization and labor from site's previous removal activity costs, truck purchase - Means (108-801-4200), transportation and disposal based on quotes [EQ Landfill, MI], other costs based on PRP consultant estimates.

Schedule Estimate (16 months) based on FS estimate of 26 months for 8860 cy, 5360/8860 = 0.6, 26 x 0.6 = 16

* O&M Costs - assumed long-term fish and sediment monitoring over a 30-year period. Fish monitoring annually, sediment sampling every 5 years. Fish monitoring - $140,000 with an additional $35,000 every 5th for sediment monitoring. Present worth calculated assuming an initial cash outlay and using a discount rate of 7%, over the 30-year period as suggested by US EPA's Draft Remedy Cost Estimating Procedures Manual.

Summary of Present Worth Analysis

Upper River Alternative 2 - Disposal of CTF and SMF Sediment & Natural Recovery

Year	Capital Cost	Annual O&M Cost Fish Monitoring	Sediment Monitoring	Total Cost	Discount Factor (7%)	Present Worth
0	$2,553,513	$140,000	$35,000	$2,728,513	1.000	$2,728,513
1		$140,000		$140,000	0.935	$130,841
2		$140,000		$140,000	0.873	$122,281
3		$140,000		$140,000	0.816	$114,282
4		$140,000		$140,000	0.763	$106,805
5		$140,000	$35,000	$175,000	0.713	$124,773
6		$140,000		$140,000	0.666	$93,288
7		$140,000		$140,000	0.623	$87,185
8		$140,000		$140,000	0.582	$81,481
9		$140,000		$140,000	0.544	$76,151
10		$140,000	$35,000	$175,000	0.508	$88,961
11		$140,000		$140,000	0.475	$66,513
12		$140,000		$140,000	0.444	$62,162
13		$140,000		$140,000	0.415	$58,095
14		$140,000		$140,000	0.388	$54,294
15		$140,000	$35,000	$175,000	0.362	$63,428
16		$140,000		$140,000	0.339	$47,423
17		$140,000		$140,000	0.317	$44,320
18		$140,000		$140,000	0.296	$41,421
19		$140,000		$140,000	0.277	$38,711
20		$140,000	$35,000	$175,000	0.258	$45,223
21		$140,000		$140,000	0.242	$33,812
22		$140,000		$140,000	0.226	$31,600
23		$140,000		$140,000	0.211	$29,533
24		$140,000		$140,000	0.197	$27,601
25		$140,000	$35,000	$175,000	0.184	$32,244
26		$140,000		$140,000	0.172	$24,107
27		$140,000		$140,000	0161	$22,530
28		$140,000		$140,000	0.150	$21,056
29		$140,000		$140,000	0.141	$19,679
30		$140,000	$35,000	$175,000	0.131	$22,989
Totals	$2,553.513	$4,340.000	$245.000	$7,138.513		**$4,541,302**

Assumptions: Construction expected 9 out of 12 months each year.
Capital Costs Obtained from Feasibility Study and Timephase Based on Project Duration - 16 months

SHEBOYGAN RIVER & HARBOR SUPERFUND SITE
UPPER RIVER - PRP FS ASSUMPTIONS

SUMMARY OF CAPITAL and O&M COSTS

Alternative: 3-II
Description: Sediment in Access Areas 123, 5, 6, 7
SWAC of 2.8 ppm, PCB Mass Red of 62%
Site: Sheboygan River & Harbor
Location: Sheboygan, WI
Date Prepared: 04/07/2000

Expected Accuracy Range: FS: -30%/+50%
Present Net Worth Discount Rate: 7.0%
Base Year of Estimate: 2000
Capital Cost Years: 2 - 4
O&M Cost Years: 1 - 30

	Description	Quantity	Unit	Unit Cost	Cost	Totals	Notes
	Capital Cost (Year 2000)						
1	Mobilization / Demobilization	1	Lump Sum	5.0%	$392,558	$392,558	
2	Monitor, Samp, Test, & Analy.	7,485	Cubic Yards	$125.00	$935,625	$935,625	
	Monitoring During Dredging						
3	Site Work						
	Access Area Development	175,000	Sq. Ft.	$4.40	$770,000	$770,000	
	(Access Areas 123,5,6,7)						
4	Excavation / Collection / Extraction	7,485	Cubic Yards	$450.00	$3,368,250	$5,871,097	
	Prepare/Perform Dredging	7,485	Cubic Yards	$110.00	$823,350		
	Transport Sediment to CTF	21	Months Cubic	$30,000.00	$630,000		
	Labor	14,450	Yards Lump	$10.00	$144,497		
	Load Stabilized Sediment	1	Sum Lump	$225,000.00	$225,000		
	CTF Liner Replace. & Main.	1	Sum	$650,000.00	$650,000		
	Decommission/Dismantle CTF/ SMP	1	Lump Sum	$30,000.00	$30,000		
	Portable Truck Purchase						
5	Containment / Control						
6	On-Site Treatment					$924,431	
	Stabilization - System Purchase	1	Lump Sum	$850,000.00	$850,000		
	Stabilization - Sediment	3,722	TON	$20.00	$74,431		
7	Off-Site Treatment / Disposal					$2,312,090	
	Transport & Dispose In-State	7,707	Tons	$40.00	$308,279		sediments < 50 ppm
	Transport & Dispose Out-of-State	14,313	Tons	$140.00	$2,003,812		sediments > 50 ppm
8	Site Controls						
9	Institutional Controls						
	SUBTOTAL					$11,205,801	
10	Contingency			10.0%	$1,120,580	$1,120,580	
	SUBTOTAL					$12,326,381	
11	Project Management & Support					$1,897,580	
	Engineering / Design			10.0%	$1,120,580		
	Construction Management	21	Months	$37,000.00	$777,000		
	TOTAL CAPITAL COSTS					$14,223,961	
	O&M Costs *				$4,550,000	$4,550,000	
	TOTAL CAPITAL & O&M COSTS					**$18,773,961**	
	NET PRESENT WORTH OF CAPITAL & O&M COSTS					**$13,808,881**	

Assumptions: Unit Costs derived from PRP FS: access development, dredging, monitoring, stabilization and labor from site's previous removal activity costs, truck purchase - Means (108-801-4200), transportation and disposal based on quotes [EQ Landfill, MI], other costs based on PRP consultant estimates.

Schedule Estimate (50 months) based on FS estimate of 26 months for 8860 cy, 7485/8860 = 0.8, 26 x 0.8 = 21

* O&M Costs - assumed long-term fish and sediment monitoring over a 30-year period. Fish monitoring annually, sediment sampling every 5 years. Fish monitoring - $140,000 with an additional $35,000 every 5th for sediment monitoring. Present worth calculated assuming an initial cash outlay and using a discount rate of 7%, over the 30-year period as suggested by US EPA's Draft Remedy Cost Estimating Procedures Manual.

Summary of Present Worth Analysis
Upper River Sediment Removal Alternative 3-I

Year	Capital Cost	Annual O&M Cost Fish Monitoring	Sediment Monitoring	Total Cost	Discount Factor (7%)	Present Worth
0		$140,000		$140,000	1.000	$140,000
1		$140,000		$140,000	0.935	$130,841
2	$6,029,079	$140,000		$6,169,079	0.873	$5,388,313
3	$4,689,284	$140,000	$35,000	$4,864,284	0.816	$3,970,705
4		$140,000		$140,000	0.763	$106,805
5		$140,000		$140,000	0.713	$99,818
6		$140,000		$140,000	0.666	$93,288
7		$140,000		$140,000	0.623	$87,185
8		$140,000	$35,000	$175,000	0.582	$101,852
9		$140,000		$140,000	0.544	$76,151
10		$140,000		$140,000	0.508	$71,169
11		$140,000		$140,000	0.475	$66,513
12		$140,000		$140,000	0.444	$62,162
13		$140,000	$35,000	$175,000	0.415	$72,619
14		$140,000		$140,000	0.388	$54,294
15		$140,000		$140,000	0.362	$50,742
16		$140,000		$140,000	0.339	$47,423
17		$140,000		$140,000	0.317	$44,320
18		$140,000	$35,000	$175,000	0.296	$51,776
19		$140,000		$140,000	0.277	$38,711
20		$140,000		$140,000	0.258	$36,179
21		$140,000		$140,000	0.242	$33,812
22		$140,000		$140,000	0.226	$31,600
23		$140,000	$35,000	$175,000	0.211	$36,916
24		$140,000		$140,000	0.197	$27,601
25		$140,000		$140,000	0.184	$25,795
26		$140,000		$140,000	0.172	$24,107
27		$140,000		$140,000	0161	$22,530
28		$140,000	$35,000	$175,000	0.150	$26,320
29		$140,000		$140,000	0.141	$19,679
30		$140,000		$140,000	0.131	$18,391
Totals	$10,718,363	$4,340.000	$210.000	$15,268,363		**$11,057,616**

Assumptions: Construction expected 9 out of 12 months each year.
Capital Costs Obtained from Feasibility Study and Timephase Based on Project Duration - 16 months

SHEBOYGAN RIVER & HARBOR SUPERFUND SITE
UPPER RIVER - PRP FS ASSUMPTIONS

SUMMARY OF CAPITAL and O&M COSTS

Alternative: **3-III**
Description: **Sediment in Access Areas 2, 5, 6, 7**
SWAC of 2.6 ppm, PCB Mass Red of 62%
Site: Sheboygan River & Harbor
Location: Sheboygan, WI
Date Prepared: 04/07/2000

Expected Accuracy Range:	FS: -30%/+50%
Present Net Worth Discount Rate:	7.0%
Base Year of Estimate:	2000
Capital Cost Years:	2 - 4
O&M Cost Years:	1 - 30

	Description	Quantity	Unit	Unit Cost	Cost	Totals	Notes
	Capital Cost (Year 1998)						
1	Mobilization / Demobilization	1	Lump Sum	5.0%	$454,267	$454,267	
2	Monitor, Samp. Test, & Analy. Monitoring During Dredging	8,860	Cubic Yards	$125.00	$1,107,500	$1,107,500	
3	Site Work						
	Access Area Development (Access Areas 2,5,6,7)	200,000	Sq. Ft.	$4.40	$880,000	$880,000	
4	Excavation / Collection / Extraction					$5,809,742	
	Prepare/Perform Dredging Transport	8,860	Cubic Yards	$450.00	$3,987,000		
	Sediment to CTF Labor	8,860	Cubic Yards	$110.00	$974,600		
	Load Stabilized Sediment	26	Months	$30,000.00	$780,000		
	CTF Liner Replace. & Main.	16,314	Cubic Yards	$10.00	$163,142		
	Decommission/Dismantle CTF/ SMP	1	Lump Sum	$225,000.00	$225,000		
	Portable Truck Purchase	1	Lump Sum	$650,000.00	$650,000		
		1	Lump Sum	$30,000.00	$30,000		
5	Containment / Control						
6	On-Site Treatment					$938,104	
	Stabilization - System Purchase	1	Lump Sum	$850,000.00	$850,000		
	Stabilization - Sediment	4,405	TON	$20.00	$88,104		
7	Off-Site Treatment / Disposal					$2,480,112	
	Transport & Dispose In-State	9,920	Tons	$40.00	$396,818		sediments < 50 ppm
	Transport & Dispose Out-of-State	14,881	Tons	$140.00	$2,083,294		sediments > 50 ppm
8	Site Controls						
9	Institutional Controls						
	SUBTOTAL					$12,669,725	
10	Contingency			10.0%	$1,266,972	$1,266,972	
	SUBTOTAL					$13,936,697	
11	Project Management & Support					$2,228,972	
	Engineering / Design			10.0%	$1,266,972		
	Construction Management	26	Months	$37,000.00	$962,000		
	TOTAL CAPITAL COSTS					$16,165,670	
	O&M Costs *				$4,550,000	$4,550,000	
	TOTAL CAPITAL & O&M COSTS					**$20,715,670**	
	NET PRESENT WORTH OF CAPITAL & O&M COSTS					**$15,208,200**	

Assumptions**:** Unit Costs derived from PRP FS: access development, dredging, monitoring, stabilization and labor from site's previous removal activity costs, truck purchase - Means (108-801-4200), transportation and disposal based on quotes [EQ Landfill, MI], other costs based on PRP consultant estimates.

Schedule Estimate (16 months) based on FS estimate of 26 months for 8860 cy, 8860/8860 = 1.0, 26 x 1.0 = 26

* O&M Costs - assumed long-term fish and sediment monitoring over a 30-year period. Fish monitoring annually, sediment sampling every 5 years. Fish monitoring - $140,000 with an additional $35,000 every 5th for sediment monitoring. Present worth calculated assuming an initial cash outlay and using a discount rate of 7%, over the 30-year period as suggested by US EPA's Draft Remedy Cost Estimating Procedures Manual.

Summary of Present Worth Analysis Upper River Sediment Removal Alternative 3-II						
Year	Capital Cost	Annual O&M Cost Fish Monitoring	Sediment Monitoring	Total Cost	Discount Factor (7%)	Present Worth
0		$140,000		$140,000	1.000	$140,000
1		$140,000		$140,000	0.935	$130,841
2	$6,095,983	$140,000		$6,235,983	0.873	$5,446,749
3	$6,095,983	$140,000		$6,235,983	0.816	$5,090,420
4	$2,031,994	$140,000	$35,000	$2,206,994	0.763	$1,683,705
5		$140,000		$140,000	0.713	$99,818
6		$140,000		$140,000	0.666	$93,288
7		$140,000		$140,000	0.623	$87,185
8		$140,000		$140,000	0.582	$81,481
9		$140,000	$35,000	$175,000	0.544	$95,188
10		$140,000		$140,000	0.508	$71,169
11		$140,000		$140,000	0.475	$66,513
12		$140,000		$140,000	0.444	$62,162
13		$140,000		$140,000	0.415	$58,095
14		$140,000	$35,000	$175,000	0.388	$67,868
15		$140,000		$140,000	0.362	$50,742
16		$140,000		$140,000	0.339	$47,423
17		$140,000		$140,000	0.317	$44,320
18		$140,000		$140,000	0.296	$41,421
19		$140,000	$35,000	$175,000	0.277	$48,389
20		$140,000		$140,000	0.258	$36,179
21		$140,000		$140,000	0.242	$33,812
22		$140,000		$140,000	0.226	$31,600
23		$140,000		$140,000	0.211	$29,533
24		$140,000	$35,000	$175,000	0.197	$34,501
25		$140,000		$140,000	0.184	$25,795
26		$140,000		$140,000	0.172	$24,107
27		$140,000		$140,000	0161	$22,530
28		$140,000		$140,000	0.150	$21,056
29		$140,000	$35,000	$175,000	0.141	$24,598
30		$140,000		$140,000	0.131	$18,391
Totals	$14,223,961	$4,340.000	$210.000	$18,773,961		**$13,808,881**

Assumptions: Construction expected 9 out of 12 months each year.
Capital Costs Obtained from Feasibility Study and Timephase Based on Project Duration - 21 months

SHEBOYGAN RIVER & HARBOR SUPERFUND SITE
UPPER RIVER - PRP FS ASSUMPTIONS

SUMMARY OF CAPITAL and O&M COSTS

Alternative: 3-IV
Description: Sediment in Access Areas 123, 5, 6, 7
SWAC of 2.0 ppm, PCB Mass Red of 78%
Site: Sheboygan River & Harbor
Location: Sheboygan, WI
Date Prepared: 04/07/2000

Expected Accuracy Range: FS: -30%/+50%
Present Net Worth Discount Rate: 7.0%
Base Year of Estimate: 2000
Capital Cost Years: 2 - 6
O&M Cost Years: 1 - 30

	Description	Quantity	Unit	Unit Cost	Cost	Totals	Notes
	Capital Cost (Year 2000)						
1	Mobilization / Demobilization	1	Lump Sum	5.0%	$649,463	$649,463	
2	Monitor, Samp. Test, & Analy.	13,742	Cubic Yards	$125.00	$1,717,750	$1,717,750	
	Monitoring During Dredging						
3	Site Work						
	Access Area Development	175,000	Sq. Ft.	$4.40	$770,000	$770,000	
4	Excavation / Collection / Extraction					$10,164,862	
	Prepare/Perform Dredging	13,472	Cubic Yards	$450.00	$6,183,900		
	Transport Sediment to CTF	13,472	Cubic Yards	$110.00	$1,511,620		
	Labor	42	Months	$30,000.00	$1,260,000		
	Load Stabilized Sediment	22,934	Cubic Yards	$10.00	$229,342		
	CTF Liner Replace. & Main.	1	Lump Sum	$300,000.00	$300,000		
	Decommission/Dismantle CTF/ SMP	1	Lump Sum	$650,000.00	$650,000		
	Portable Truck Purchase	1	Lump Sum	$30,000.00	$30,000		
5	Containment / Control						
6	On-Site Treatment					$986,650	
	Stabilization - System Purchase	1	Lump Sum	$850,000.00	$850,000		
	Stabilization - Sediment	6,833	TON	$20.00	$136,650		
7	Off-Site Treatment / Disposal					$2,912,779	
	Transport & Dispose In-State	19,419	Tons	$40.00	$776,741		sediments < 50 ppm
	Transport & Dispose Out-of-State	15,257	Tons	$140.00	$2,136,038		sediments > 50 ppm
8	Site Controls						
9	Institutional Controls						
	SUBTOTAL					$17,201,504	
10	Contingency			10.0%	$1,720,150	$1,720,150	
	SUBTOTAL					$18,921,655	
11	Project Management & Support					$3,274,150	
	Engineering / Design			10.0%	$1,720,150		
	Construction Management	42	Months	$37,000.00	$1,554,000		
	TOTAL CAPITAL COSTS					$22,195,805	
	O&M Costs *				$4,515,000	$4,515,000	
	TOTAL CAPITAL & O&M COSTS					**$26,710,805**	
	NET PRESENT WORTH OF CAPITAL & O&M COSTS					**$19,112,860**	

Assumptions:
Unit Costs derived from PRP FS: access development, dredging, monitoring, stabilization and labor from site's previous removal activity costs, truck purchase - Means (108-801-4200), transportation and disposal based on quotes [EQ Landfill, MI], other costs based on PRP consultant estimates.

Schedule Estimate (42 months) based on FS estimate of 26 months for 8860 cy, 13742/8860 = 1.6, 26 x 1.6 = 42

* O&M Costs - assumed long-term fish and sediment monitoring over a 30-year period. Fish monitoring annually, sediment sampling every 5 years. Fish monitoring - $140,000 with an additional $35,000 every 5th for sediment monitoring. Present worth calculated assuming an initial cash outlay and using a discount rate of 7%, over the 30-year period as suggested by US EPA's Draft Remedy Cost Estimating Procedures Manual.

Summary of Present Worth Analysis
Upper River Sediment Removal Alternative 3-III

Year	Capital Cost	Annual O&M Cost Fish Monitoring	Sediment Monitoring	Total Cost	Discount Factor (7%)	Present Worth
0		$140,000		$140,000	1.000	$140,000
1		$140,000		$140,000	0.935	$130,841
2	$5,595,809	$140,000		$5,735,809	0.873	$5,009,878
3	$5,595,809	$140,000		$5,735,809	0.816	$4,682,129
4	$4,974,052	$140,000	$35,000	$5,149,052	0.763	$3,928,187
5		$140,000		$140,000	0.713	$99,818
6		$140,000		$140,000	0.666	$93,288
7		$140,000		$140,000	0.623	$87,185
8		$140,000		$140,000	0.582	$81,481
9		$140,000	$35,000	$175,000	0.544	$95,188
10		$140,000		$140,000	0.508	$71,169
11		$140,000		$140,000	0.475	$66,513
12		$140,000		$140,000	0.444	$62,162
13		$140,000		$140,000	0.415	$58,095
14		$140,000	$35,000	$175,000	0.388	$67,868
15		$140,000		$140,000	0.362	$50,742
16		$140,000		$140,000	0.339	$47,423
17		$140,000		$140,000	0.317	$44,320
18		$140,000		$140,000	0.296	$41,421
19		$140,000	$35,000	$175,000	0.277	$48,389
20		$140,000		$140,000	0.258	$36,179
21		$140,000		$140,000	0.242	$33,812
22		$140,000		$140,000	0.226	$31,600
23		$140,000		$140,000	0.211	$29,533
24		$140,000	$35,000	$175,000	0.197	$34,501
25		$140,000		$140,000	0.184	$25,795
26		$140,000		$140,000	0.172	$24,107
27		$140,000		$140,000	0161	$22,530
28		$140,000		$140,000	0.150	$21,056
29		$140,000	$35,000	$175,000	0.141	$24,598
30		$140,000		$140,000	0.131	$18,391
Totals	$16,165,670	$4,340,000	$210,000	$20,715,670		**$15,208,200**

Assumptions: Construction expected 9 out of 12 months each year.
Capital Costs Obtained from Feasibility Study and Timephase Based on Project Duration - 26 months

EXHIBITS

EXHIBIT 1 - Variables and Values Used in Assessing Human Health Post- Remedial Risks

-post-remedial fish tissue levels in BASS

CUG and CF values are in ppm

CUG	TOC	lipid	BSAF	CF
2.8	5.3	0.715	4.54	1.714920755
1	5.3	0.715	4.54	0.612471698
0.6	5.3	0.715	4.54	0.367483019
0.5	5.3	0.715	4.54	0.306235849
0.4	5.3	0.715	4.54	0.244988679
0.3	5.3	0.715	4.54	0.183741509
0.1	5.3	0.715	4.54	0.6124717

sediment-	select from remedial spreadsheets	**lipid-**	from FIELD ‘94 average of sm bass fillets
TOC-	see TOC sheet of this file	**BSAF-**	see sheb_fshtss file

-Input estimated fish tissue levels into Risk equation

RME - Small mouth Bass

Cancer		2.8 ppm CUG	1.0 ppm CUG	0.6 ppm CUG	0.5 ppm CUG	0.4 ppm CUG	0.3 ppm CUG	0.1 ppm CUG
		ú	ú	ú	ú	ú	ú	ú
	CF	1.714920755	0.612471698	0.367483019	0.306235849	0.244988679	0.183741509	0.06124717
	BW	70	70	70	70	70	70	70
	AT	25550	25550	25550	25550	25550	25550	25550
	IR	0.054	0.054	0.054	0.054	0.054	0.054	0.054
	FI	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	AB	1	1	1	1	1	1	1
	EF	365	365	365	365	365	365	365
	ED	30	30	30	30	30	30	30
	slope	2	2	2	2	2	2	2
	RISK	5.67E-04	2.02E-04	1.21E-04	1.01E-04	8.10E-05	6.07E-05	2.02E-05

Non-Cancer		2.8 ppm CUG	1.0 ppm CUG	0.6 ppm CUG	0.5 ppm CUG	0.4 ppm CUG	0.3 ppm CUG	0.1 ppm CUG
		ú	ú	ú	ú	ú	ú	ú
	CF	1.714920755	0.612471698	0.367483019	0.306235849	0.244988679	0.183741509	0.06124717
	BW	70	70	70	70	70	70	70
	AT	10950	10950	10950	10950	10950	10950	10950
	IR	0.054	0.054	0.054	0.054	0.054	0.054	0.054
	FI	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	AB	1	1	1	1	1	1	1
	EF	365	365	365	365	365	365	365
	ED	30	30	30	30	30	30	30
	RfD	2.00E-05	2.00E-05	2.00E-05	2.00E-05	2.00E-05	2.00E-05	2.00E-05
	HQ	33.07	11.81	7.09	5.91	4.72	3.54	1.18

CF: concentration in fish	AT: averaging time	FI: fraction ingested	EF: exposure frequency
BW. body weight	IR: ingestion rate	AB: absorption	ED: exposure duration

Exhibit 2 - Frequency of Soft Bottom Types Associated with State-wide Surveys of Fish Species Reported to Forage in the Sheboygan River [a]

Common Name	Scientific Name	Frequency of bottom Type (%) [b]				
		Sand	Silt	Mud	Silt/Mud[c]	Total[d]
Smallmouth bass	*Micropterus dolomieu*	23	7	11	18	41
Rock bass	*Ambloplites rupestris*	26	9	13	22	48
Bluegill	*Lepomis macrochirus*	29	11	17	28	57
Pumpkinseed	*Lepomis gibbosus*	28	13	18	31	59
Black crapppie	*Pomoxis nigromaculatus*	32	9	20	29	61
Common carp	*Cyprinus carpio*	29	9	19	28	57
White sucker	*Catostomus comersoni*	22	14	12	26	48
Redhorse species [e]	*Moxostoma* spp.	18-28	5-9	14-19	21-24	39-52
Common shiner	*Notropis cornutus* [f]	23	11	12	23	46
Sand shiner	*Notropis stamineus*	24	11	12	23	47
Horny head chub	*Nokomis biguttatus*	20	12	9	21	41
Longnose dace	*Rhinichthys cataractae*	20	10	7	17	37
Channel catfish [g]	*Ictaleurus punctatus*	2nd highest frequency	low frequency	highest frequency		
Stonecat	*Noturus flavus*	12	6	8	14	26
Walleye [g]	*Stizostedion vitreum*	highest frequency	low frequency	3rd highest frequency		
Blackside darter	*Percina maculata*	27	9	12	21	48
Log perch	*Percina caprodes*	34	7	10	17	51
Northern pike	*Esox lucius*	27	10	21	31	58

a) List of resident fish species that forage in the Sheboygan River is based on Table 2-1 of the AERA (1998).
b) Percentage frequency of bottom type "reported in the location of the collection" for fish surveys performed throughout Wisconsin over a 20-year period from the late 1950's to the late 1970's (Becker 1983). Other categories include gravel, rubble, boulders, bedrock, hardpan, detritus, clay, and marl.
c) Combined silt and mud frequencies.
d) Sum of sand, silt and mud frequencies.
e) Range of values for golden (*M. erythrurum*), silver (*M. anisurum*), and shorthead (*M. Macrolepidotum*) redhorse.
f) Listed as *Luxilus cornutus* in Table 2-1 of the Sheboygan River and Harbor AERA (1998).
g) Bottom types qualitatively listed in descending order of frequency (Becker 1983).

EXHIBIT 3
Sheboygan River and Harbor Superfund Site
Upper River SWAC calculations
Feasibility Study Approach

Removal Alternative / Volume of Sed. Removed	Area	(A) Sediment Volume (cy)	(B) Individual SWAC (ppm) 1997	(C) Total Sediment Area (sq. ft.)	(D) (B) * (C) SWAC 1997 WEIGHTS	(E) 0.1 * (D) SWAC POST WEIGHT	(F) Cumulative SWAC (ppm)	PCB Mass (kg)	Cumulative PCB Mass Removed (kg) (90% reduction)	PCB Mass Remaining (kg)	Cumulative % of PCB Mass Removed (90% reduction)	Cumulative Sediment Vol. (cy)
Current conditions							3.6	282.3				
	26	2148	3.1	19775	60512	6051	3.4	50.4	45.4	236.9	16.1%	
	42	1050	1.0	12900	12642	1264	3.4	16.0	59.8	222.5	21.2%	3197
	21	150	5.5	2300	12604	1260	3.3	15.9	74.1	208.2	26.2%	3347
	45	1508	5.1	20325	103251	10325	3.0	9.6	82.7	199.6	29.3%	4855
	24	236	4.6	3150	14616	1462	3.0	7.1	89.1	193.2	31.6%	5091
3-I	40	269	3.7	3875	14415	1442	2.9	6.0	94.5	187.8	33.5%	5360
	10	501	2.4	2000	4700	470	2.9	54.0	143.1	139.2	50.7%	5861
	5A	486	2.4	2625	6169	617	2.9	17.2	158.6	123.7	56.2%	6347
	11	241	2.4	1050	2468	247	2.9	8.4	166.1	116.2	58.9%	6587
	8	205	2.4	1000	2350	235	2.9	2.6	168.5	113.8	59.7%	6792
	15A	404	1.9	5850	11232	1123	2.9	2.6	170.8	111.5	60.5%	7196
	Island Area	68	27.7	960	26630	2663	2.8	2.0	172.6	109.7	61.1%	7263
	4	80	2.4	1200	2820	282	2.8	0.9	173.4	108.9	61.4%	7344
	2	48	2.4	1500	3525	353	2.8	0.7	174.1	108.2	61.7%	7391
	7	60	2.4	400	940	94	2.8	0.6	174.6	107.7	61.8%	7451
3-II	3	34	2.4	360	846	85	2.8	0.5	175.1	107.3	62.0%	7485
	35	874	3.9	9250	35705	3571	2.6	19.2	192.3	90.0	68.1%	8359
3-III	39	502	4.8	5450	25888	2589	2.6	12.1	203.2	79.1	72.0%	8860
3-IV	31	4882	2.7	66100	179131	17913	2.0	18.6	220.0	62.3	77.9%	13742
	44	2099	4.3	28700	123697	12370	1.7	3.6	223.2	59.1	79.1%	15842
	23	544	5.6	8400	46956	4696	1.5	3.2	226.1	56.2	80.1%	16386
	1	263	2.4	2800	6580	658	1.5	7.7	233.0	49.3	82.5%	16649
	39A	72	16.0	1500	24000	2400	1.5	1.9	234.7	47.6	83.1%	16721
	39B	246	4.0	5450	21691	2169	1.4	1.6	236.2	46.1	83.7%	16967
	41	677	2.3	9225	21310	2131	1.3	1.7	237.7	44.6	84.2%	17645
	13	267	5.8	2750	16005	1601	1.3	1.6	239.1	43.2	84.7%	17912

EXHIBIT 3

Sheboygan River and Harbor Superfund Site

Upper River SWAC calculations

Feasibility Study Approach

Removal Alternative / Volume of Sed. Removed	Area	(A) Sediment Volume (cy)	(B) Individual SWAC (ppm) 1997	(C) Total Sediment Area (sq. ft.)	(D) (B) * (C) SWAC 1997 WEIGHTS	(E) 0.1 * (D) SWAC POST WEIGHT	(F) Cumulative SWAC (ppm)	PCB Mass (kg)	Cumulative PCB Mass Removed (kg) (90% reduction)	PCB Mass Remaining (kg)	Cumulative % of PCB Mass Removed (90% reduction)	Cumulative Sediment Vol. (Cy)
	20A	395	1	7700	11319	1132	1.2	1.4	240.4	41.9	85.2%	18307
	36	116	18.9	3100	58590	5859	1.1	2.9	243.0	39.3	86.1%	18423
	25	397	2.0	5750	11558	1156	1.0	1.7	244.5	37.8	86.6%	18820
	37	22	8.9	3000	26700	2670	1.0	1.3	245.7	36.6	87.0%	18842
	19	311	3.7	6000	22080	2208	0.9	1.3	246.9	35.4	87.4%	19153
	22	249	4.4	6250	27250	2725	0.8	1.2	248.0	34.4	87.8%	19402
	20	252	6.1	4650	28365	2837	0.7	1.1	248.9	33.4	88.2%	19654
	30	615	1.0	8550	8379	838	0.7	0.7	249.6	32.7	88.4%	20269
	33	136	3.9	2975	11573	1157	0.7	0.6	250.1	32.2	88.6%	20405
	15	224	2.0	6000	11820	1182	0.6	0.6	250.7	31.7	88.8%	20629
3-IV-A	32	143	3.1	1500	4605	461	0.6	0.5	251.1	31.2	88.9%	20773
	34	83	1.0	1600	1616	162	0.6	0.4	251.5	30.8	89.1%	20856
	28A	145	11.2	2600	28990	2899	0.5	0.4	251.8	30.5	89.8%	21001
	5	163	2.4	1500	3540	354	0.5	0.4	252.2	30.1	89.3%	21163
	16	62	5.4	1500	8040	804	0.5	0.4	252.5	29.8	89.5%	21225
	9	83	3.2	3000	9600	960	0.5	0.3	252.8	29.5	89.6%	21308
	12	356	0.9	2400	2136	214	0.5	0.3	253.1	29.2	89.6%	21664
	19A	153	1.4	2850	3962	396	0.5	0.2	253.3	29.0	89.7%	21817
	6	2	21.0	250	5250	525	0.4	0.2	253.4	28.9	89.8%	21819
	46	26	2.0	1300	2600	260	0.4	0.1	253.5	28.8	89.8%	21845
	27A	147	1.7	2775	4634	463	0.4	0.1	253.6	28.7	89.8%	21991
	27	119	1.1	2700	2970	297	0.4	0.1	253.7	28.6	89.9%	22111
	43	173	1.1	3600	3960	396	0.4	0.1	253.8	28.5	89.9%	22284
	29	116	1.4	2125	2996	300	0.4	0.1	253.9	28.4	89.9%	22400
	28	13	4.0	1500	5940	594	0.4	0.1	254.0	28.3	90.0%	22412
	18	14	2.9	320	938	94	0.4	0.1	254.1	28.2	90.0%	22426
	17	9	14.9	240	3574	357	0.4	0.0	254.1	28.2	90.0%	22435

EXHIBIT 3
Sheboygan River and Harbor Superfund Site
Upper River SWAC calculations
Feasibility Study Approach

Removal Alternative / Volume of Sed. Removed	Area	(A) Sediment Volume (cy)	(B) Individual SWAC (ppm) 1997	(C) Total Sediment Area (sq. ft.)	(D) (B) * (C) SWAC 1997 WEIGHTS	(E) 0.1 * (D) SWAC POST WEIGHT	(F) Cumulative SWAC (ppm)	PCB Mass (kg)	Cumulative PCB Mass Removed (kg) (90% reduction)	PCB Mass Remaining (kg)	Cumulative % of PCB Mass Removed (90% reduction)	Cumulative Sediment Vol. (cy)
	15B	74	0.2	1250	250	25	0.4	0.0	254.1	28.2	90.0%	22509
3-V	14	15	1.6	600	978	98	0.4	0.0	254.1	28.2	90.0%	22524
	TOTAL	22524		306480	1094893							

Note: * = within the FS, 1989 values were inadvertently used; these values have been corrected herein to reflect 1997 values. Cumulative SWAC changes resulting from corrected values are within rounding accuracy, except for Removal Alternative II which changes from 2.7 ppm (as presented in the FS) to 2.8 ppm, as noted herein.

EXHIBIT 4

Sheboygan River and Harbor Superfund Site

Upper River SWAC calculations

Through PCB SWAC Reduction To 1.5 ppm Then Through Mass Reduction

Access Area	Area	(A) Sediment Volume (cy)	(B) Individual SWAC (ppm) 1997	(C) Total Sediment Area (sq. ft.)	PCB Mass (kg)	(D) (B) * (C) SWAC 1997 WEIGHTS	(E) 0.1 * (D) SWAC POST WEIGHT	(F) Cumulative SWAC (ppm)	Cumulative PCB Mass Removed (kg) (90% reduction)	PCB Mass Remaining (kg)	Cumulative % of PCB Mass Removed (90% reduction)	Cumulative Sediment Vol.
Current conditions					282.3			3.6				
5	31	4882	2.7	66100	18.6	179131	17913	3.0	16.7	265.6	5.9%	4882
7	44	2099	4.3	28700	3.6	123697	12370	2.7	200	262.3	7.1%	6982
7	45	1508	5.1	20325	9.6	10351	10325	2.4	28.6	253.7	10.1%	8489
5	26	2148	3.1	19775	50.4	60512	6051	2.2	74.0	208.3	26.2%	10637
6	36	116	18.9	3100	2.9	58590	5859	2.0	76.6	205.7	27.1%	10752
5	23	544	5.6	8400	3.2	46956	4696	1.9	79.5	202.8	28.2%	11297
6	35	874	3.9	9250	19.2	35705	3571	1.8	96.8	185.6	34.3%	12170
5	28A	145	11.2	2600	0.4	28990	2899	1.7	97.1	285.2	3434%	12315
5	20	252	6.1	4650	1.1	28365	2837	1.6	98.1	184.2	34.8%	12567
5	22	249	4.4	6250	1.2	27250	2725	1.5	99.2	183.1	35.1%	12816
123	10	501	2.4	2000	54.0	4700	470	1.5	147.8	134.5	52.3%	13317
123	5A	486	2.4	2625	17.2	6169	617	1.5	163.3	119.0	57.8%	13803
7	42	1050	1.0	12900	16.0	12642	1264	1.5	177.7	104.6	62.9%	14853
5	21	150	5.5	2300	15.9	12604	1260	1.4	192.0	90.3	68.0%	15003
6	39	502	4.8	5450	12.1	2888	2589	1.4	202.9	79.4	71.9%	15504
123	11	241	2.4	1050	8.4	2468	247	1.3	210.4	71.9	74.5%	15745
123	1	263	2.4	2800	7.7	6580	658	1.3	217.4	65.0	77.0%	16008
5	24	236	4.6	3150	7.1	14616	1462	1.2	223.7	58.6	79.3%	16244
7	40	269	3.7	3875	6.0	14415	1442	1.1	229.1	53.2	81.2%	16513
123	8	205	2.4	1000	2.6	2350	235	1.0	231.5	5.8	8.20%	16718
4	15A	404	1.9	5850	2.6	11232	1123	1.0	233.8	48.5	82.8%	17121
123	Island Area	68	27.7	960	2.0	26630	2663	0.9	235.6	46.7	83.5%	17189
6	39A	72	16.0	1500	1.9	24000	2400	0.9	237.3	45.0	84.1%	17261
5	25	397	2.0	5750	1.7	11558	1156	0.8	238.9	43.4	86.4%	17658
7	41	677	2.3	9225	1.7	21310	2131	0.8	240.4	41.9	85.2%	18336
6	39B	246	4.0	5450	1.6	21691	2169	0.7	241.8	40.5	85.7%	18582

EXHIBIT 4
Sheboygan River and Harbor Superfund Site
Upper River SWAC calculations
Through PCB SWAC Reduction To 1.5 ppm Then Through Mass Reduction

Access Area	Area	(A) Sediment Volume (cy)	(B) Individual SWAC (ppm) 1997	(C) Total Sediment Area (sq. ft.)	PCB Mass (kg)	(D) (B) * (C) SWAC 1997 WEIGHTS	(E) 0.1 * (D) SWAC POST WEIGHT	(F) Cumulative SWAC (ppm)	Cumulative PCB Mass Removed (kg) (90% reduction)	PCB Mass Remaining (kg)	Cumulative % of PCB Mass Removed (90% reduction)	Cumulative Sediment Vol.
123	13	267	5.8	2750	1.6	16005	1601	0.7	243.3	39.0	86.2%	18849
5	20A	395	1	7700	1.4	11319	1132	0.6	244.5	37.8	86.6%	19244
6	37	22	8.9	3000	1.3	26700	2670	0.6	245.7	36.6	87.0%	19266
5	19	311	3.7	6000	1.3	22080	2208	0.6	246.9	35.4	87.4%	19577
123	4	80	2.4	1200	0.9	2820	282	0.6	247.7	34.6	87.7%	19657
123	2	48	2.4	1500	0.7	3525	353	0.6	248.3	34.0	88.0%	19705
5	30	615	1.0	8550	0.7	8379	838	0.6	248.9	33.4	88.2%	20320
6	33	136	3.9	2975	0.6	11573	1157	0.6	249.5	32.8	88.4%	20456
5	15	224	2.0	6000	0.6	11820	1182	0.5	250.0	32.3	88.6%	20680
123	7	60	2.4	400	0.6	940	94	0.5	250.6	31.7	88.8%	20740
	3	34	2.4	360	0.5	846	85	0.5	251.0	31.3	88.9%	20774
	32	143	3.1	1500	0.5	4605	461	0.5	251.5	30.8	89.1%	20917
	34	83	1.0	1600	0.4	1616	162	0.5	251.8	30.5	89.2%	21001
	5	163	2.4	1500	0.4	3540	354	0.5	252.2	30.1	89.3%	21163
	16	62	5.4	1500	0.4	8040	804	0.4	252.5	29.8	89.5%	21225
	12	356	0.9	2400	0.3	2136	214	0.4	252.8	29.5	89.6%	21581
123	9	83	3.2	3000	0.3	9600	960	0.4	253.1	29.2	89.6%	21664
	6	2	21.0	250	0.2	5250	525	0.4	253.3	29.0	89.7%	21666
	19A	153	1.4	2850	0.2	3962	396	0.4	253.4	28.9	89.8%	21819
	18	14	2.9	320	0.1	938	94	0.4	253.5	28.8	89.8%	21832
	28	13	4.0	1500	0.1	5940	594	0.4	253.6	28.7	89.8%	21845
	46	26	2.0	1300	0.1	2600	260	0.4	253.7	28.6	89.9%	21871
	27	119	1.1	2700	0.1	2970	297	0.4	253.8	28.5	89.9%	21990
	29	116	1.4	2125	0.1	2996	300	0.4	253.9	28.4	89.9%	22106
	43	173	1.1	3600	0.1	3960	396	0.4	254.0	28.3	90.0%	22279
	27A	147	1.7	2775	0.1	4634	463	0.4	254.1	28.2	90.0%	22426
	14	15	1.6	600	0.0	978	98	0.4	254.1	28.2	90.0%	22440

EXHIBIT 4
Sheboygan River and Harbor Superfund Site
Upper River SWAC calculations
Through PCB SWAC Reduction To 1.5 ppm Then Through Mass Reduction

Access Area	Area	(A) Sediment Volume (cy)	(B) Individual SWAC (ppm) 1997	(C) Total Sediment Area (sq. ft.)	PCB Mass (kg)	(D) (B) * (C) SWAC 1997 WEIGHT	(E) 0.1 * (D) SWAC POST WEIGHT	(F) Cumulative SWAC (ppm)	Cumulative PCB Mass Removed (kg) (90% reduction)	PCB Mass Remaining (kg)	Cumulative % of PCB Mass Removed (90% reduction)	Cumulative Sediment Vol.
	17	9	14.9	240	0.0	3574	357	0.4	254.1	28.2	90.0%	22450
	15B	74	0.2	1250	0.0	250	25	0.4	254.1	28.2	90.0%	22524
	TOTAL	22524		306480		1094893						

file:SWAC_90c.123

EXHIBIT 5
Sheboygan River and Harbor Superfund Site
Middle River SWAC calculations

Area	(A) Sediment Volume (cy)	(B) PCB Concentration (ppm)	(C) Total Sediment Area (sq. ft.)	(D) (B) * (C) SWAC 1997 WEIGHT	(E) 0.1 * (D) SWAC POST WEIGHT	PCB Mass (kg)	(F) Cumulative SWAC (ppm)	Cumulative PCB Mass Removed (kg) (90% reduction)	PCB Mass Remaining (kg)	Cumulative % of PCB Mass Removed (90% reduction)	Cumulative Sediment Vol. (cy)
Current conditions						60.6	1.5				
R10 6	4377	2.8	90900	254520	25452	12.2	1.3	11.0	49.7	18.1%	4377
R67	733	8.4	22000	184800	18480	6.1	1.0	16.5	44.1	27.2%	5110
R46	867	7.1	15600	110760	11076	6.1	0.9	22.0	38.6	36.3%	5977
R72	1056	3.3	28500	94050	9405	3.5	0.8	25.1	35.5	41.4%	7033
R59	2427	1.5	54600	81900	8190	3.6	0.7	28.4	32.3	46.8%	9460
R70	3033	1.0	58500	58500	5850	3.0	0.6	31.1	29.6	51.3%	12493
R68	328	3.2	17700	56640	5664	1.0	0.6	32.0	28.6	52.8%	12821
R54	863	8.8	6300	55440	5544	7.5	0.5	38.8	21.8	64.0%	13684
R53	1046	1.3	40350	52455	5426	1.4	0.5	40.0	20.6	66.0%	14730
R50	622	2.8	16800	47040	4704	1.7	0.4	41.6	19.0	68.6%	15352
R71	2720	1.0	45900	45900	4590	2.7	0.3	44.0	16.6	72.6%	18072
R65	932	4.0	7400	29600	2960	3.7	0.3	47.3	13.3	78.1%	19004
R57	510	3.5	7650	26775	2678	1.8	0.3	48.9	11.7	80.7%	19514
R49	692	4.3	6225	26768	2677	3.0	0.3	51.6	9.0	85.1%	20206
R51	1069	0.8	26250	21000	2100	0.9	0.2	52.4	8.2	86.4%	21275
R47	840	1.0	18900	18900	1890	0.8	0.2	53.1	7.5	87.6%	22115
R69	1851	0	35700	10710	1071	0.6	0.2	53.6	7.0	88.5%	23966
R48	200	0.9	10800	10044	1004	0.2	0.2	53.8	6.8	88.7%	24166
R64	314	1.0	7700	7700	770	0.3	0.2	54.1	6.6	89.2%	24480
R44	2613	0.1	88200	4410	441	0.1	0.2	54.2	6.4	89.4%	27093
R63	551	0.2	18600	3162	316	0.1	0.2	54.3	6.4	89.5%	27644
R61	1213	0.1	25200	2520	252	0.1	0.2	54.4	6.2	89.7%	28857
R60	922	0.0	49800	1494	149	0.0	0.2	54.4	6.2	89.7%	29779
R58	2263	0.0	43650	1310	131	0.1	0.2	54.5	6.2	89.8%	32042
R45	700	0.1	17175	1202	120	0.0	0.2	54.5	6.1	89.8%	32742
R55	440	0.1	9900	594	59	0.0	0.2	54.5	6.1	90.0%	33182
R56	833	0.0	9000	270	27	0.0	0.2	54.6	6.1	90.0%	34015
R66	152	0.1	4100	205	21	0.0	0.2	54.6	6.1	90.0%	34167

EXHIBIT 5
Sheboygan River and Harbor Superfund Site
Middle River SWAC calculations

Area	(A) Sediment Volume (cy)	(B) PCB Concentration (ppm)	(C) Total Sediment Area (sq.ft)	(D) (B) * (C) SWAC 1997 WEIGHT	(E) 0.1 * (D) SWAC POST WEIGHT	PCB Mass (kg)	(F) Cumulative SWAC (ppm)	Cumulative PCB Mass Removed (kg) (90% reduction)	PCB Mass Remaining (kg)	Cumulative % of PCB Mass Removed (90% reduction)	Cumulative Sediment Vol. (Cy)
Current conditions						60.6	1.5				
R43	0	0.6	0	0	0	0.0	0.2	54.6	6.1	90.0%	34167
R42	0	0.2	0	0	0	0.0	0.2	54.6	6.1	90.0%	34167
TOTAL	34167		783400	1208668							

PCB concentration and sediment volume data from 1987 RI activities

EXHIBIT 6
Sheboygan River and Harbor Superfund Site
Lower River SWAC calculations

	Area	(A) Sediment Volume (cy)	(B) Individual SWAC (ppm) 1997	(C) Total Sediment Area (sq.ft)	(D) (B) * (C) SWAC 1997 WEIGHTS	(E) 0.1 * (D) SWAC POST WEIGHT	PCB Mass (kg)	(F) Cumulative SWAC (ppm)	Cumulative PCB Mass Removed (kg) (90% reduction)	PCB Mass Remaining (kg)	Cumulative % of PCB Mass Removed (90% reduction)	Cumulative Sediment Vol. (Cy)
Current conditions							782.3	5.5				
	R84	13000	17.0	195000	3315000	331500	219.7	3.5	197.7	584.5	25.3%	13000
	R79	9389	14.0	97500	1365000	136500	130.7	2.7	315.3	466.9	40.3%	22389
	R80/R81	7415	5.6	143000	793650	79365	40.9	2.2	352.1	430.1	45.0%	29804
	R94	5133	11	63000	693000	69300	56.1	1.8	402.7	379.6	51.5%	34937
	R95/R96/R97	18870	3.8	107640	409032	40903	71.3	1.5	466.8	315.4	59.7%	53807
	R88	10167	4.2	91500	384300	38430	42.4	1.3	505.0	277.2	64.6%	63974
	R90/R91	10951	5.3	71250	377625	37763	57.7	1.0	556.9	225.3	71.2%	74925
	R87	9794	4.6	64500	296700	29670	44.8	0.9	597.3	185.0	76.4%	84719
	R98	26278	2.3	59125	135988	13599	60.1	0.8	651.3	130.9	83.3%	110997
	R100/R101	5667	3.3	19125	63113	6311	18.6	0.7	668.1	114.2	85.4%	116664
	R99	5833	1.5	39375	59063	5906	8.7	0.7	675.9	106.4	86.4%	122497
	R73/R74	1458	5.9	9600	56640	5664	8.6	0.7	683.6	98.7	87.4%	123955
	R92	3056	1.3	33000	42900	4290	3.9	0.6	687.1	95.1	87.8%	127011
	R77/R78	642	2.3	16500	37950	3795	1.5	0.6	688.5	93.8	88.0%	127653
	R93	3100	1.6	23250	37200	3720	4.9	0.6	692.9	89.4	88.6%	130753
	R83	21125	0.2	146250	29250	2925	4.2	0.6	696.7	85.6	89.1%	151878
	R76	1333	1.7	15000	25500	2550	2.3	0.6	698.7	83.6	89.3%	153211
	R82	29852	0.1	201500	20150	2015	3.0	0.6	701.4	80.9	89.7%	183063
	R85	3625	0.3	33750	10125	1013	1.1	0.6	702.4	79.9	89.8%	186688
	R86	8222	0.1	55500	3330	333	0.5	0.5	702.8	79.5	89.8%	194910
	R75	1067	1.3	960	1248	125	1.4	0.5	704.0	78.2	90.0%	195977
	TOTAL	195977		1486325	8156763							

Summary of Present Worth Analysis
Alt. 2 - Middle River, Characterization & Monitoring

Year	Capital Cost	Annual O&M Cost Biota Monitoring	Sediment Monitoring	Total Cost	Discount Factor (7%)	Present Worth
0		$140,000		$140,000	1.000	$140,000
1		$140,000		$140,000	0.935	$130,841
2		$140,000	$35,000	$175,000	0.873	$152,852
3		$140,000		$140,000	0.816	$114,282
4		$140,000		$140,000	0.763	$106,805
5		$140,000		$140,000	0.713	$99,818
6		$140,000		$140,000	0.666	$93,288
7		$140,000	$35,000	$175,000	0.623	$108,981
8		$140,000		$140,000	0.582	$81,481
9		$140,000		$175,000	0.544	$76,151
10		$140,000		$140,000	0.508	$71,169
11		$140,000		$140,000	0.475	$66,513
12		$140,000	$35,000	$175,000	0.444	$77,702
13		$140,000		$140,000	0.415	$58,095
14		$140,000		$140,000	0.388	$54,294
15		$140,000		$140,000	0.362	$50,742
16		$140,000		$140,000	0.339	$47,423
17		$140,000	$35,000	$175,000	0.317	$55,401
18		$140,000		$140,000	0.296	$41,421
19		$140,000		$140,000	0.277	$38,711
20		$140,000		$140,000	0.258	$36,179
21		$140,000		$140,000	0.242	$33,812
22		$140,000	$35,000	$175,000	0.226	$39,500
23		$140,000		$140,000	0.211	$29,533
24		$140,000		$140,000	0.197	$27,601
25		$140,000		$140,000	0.184	$25,795
26		$140,000		$140,000	0.172	$24,107
27		$140,000	$35,000	$175,000	0.161	$28,163
28		$140,000		$140,000	0.150	$21,056
29		$140,000		$140,000	0.141	$19,679
30		$140,000		$140,000	0.131	$18,391
Totals	$0	$4,340,000	$210,000	$4.550.000		**$1,969,785**

SHEBOYGAN RIVER & HARBOR SUPERFUND SITE
MIDDLE RIVER - SWAC TO 0.6 ppm

SUMMARY OF CAPITAL and O&M COSTS

Alternative: **3**
Description: **Sediment in Access Areas - 4**
SWAC of 0.5 ppm
Site: Sheboygan River & Harbor
Location: Sheboygan, WI
Date Prepared: 05/02/2000

Expected Accuracy Range:	FS: -30%/+50%
Present Net Worth Discount Rate:	7.0%
Base Year of Estimate:	2000
Capital Cost Years:	5 - 10
O&M Cost Years:	1 - 30

	Description	Quantity	Unit	Unit Cost	Cost	Totals	Notes
	Capital Cost (Year 2000)						
1	Mobilization / Demobilization	1	Lump Sum	5.0%	$584,408	$582,408	
2	Monitor, Samp. Test, & Analy.						
	Monitoring During Dredging	13,684	Cubic Yards	$125.00	$1,710,500	$1,710,500	
3	Site Work						
	Access Area Development	100,000	Sq. Ft.	$4.40	$440,000	$440,000	
4	Excavation / Collection / Extraction					$9,361,595	
	Prepare/Perform Dredging	13,684	Cubic Yards	$450.00	$6,157,800		
	Transport Sediment to CTF	13,684	Cubic Yards	$110.00	$1,505,240		
	Labor	49	Months	$30,000.00	$1,470,000		
	Load Stabilized Sediment	22,856	Cubic Yards	$10.00	$228,555		
5	Containment / Control						
6	On-Site Treatment					$136,074	
	Stabilization - System Purchase	0	Lump Sum	$850,000.00	$0		
	Stabilization - Sediment	6,804	TON	$20.00	$136,074		
7	Off-Site Treatment / Disposal					$1,382,345	
	Transport & Dispose In-State	34,559	Tons	$40.00	$1,382,345		sediments < 50 ppm
	Transport & Dispose Out-of-State	0	Tons	$140.00	$0		sediments > 50 ppm
8	Site Controls						
9	Institutional Controls						
	SUBTOTAL					$13,612,922	
10	Contingency			10.0%	$1,361,292	$1,361,292	
	SUBTOTAL					$14,974,214	
11	Project Management & Support					$3,174,292	
	Engineering / Design			10.0%	$1,361,292		
	Construction Management	49	Months	$37,000.00	$1,813,000		
	TOTAL CAPITAL COSTS					$18,148,507	
	O&M Costs *				$1,824,123	$1,824,123	
	TOTAL CAPITAL & O&M COSTS					**$13,107,903**	

Assumptions:
Unit Costs derived from PRP FS: access development, dredging, monitoring, stabilization and labor from site’s previous removal activity costs, truck purchase - Means (108-801-4200), transportation and disposal based on quotes [EQ Landfill, MI], other costs based on PRP consultant estimates.

Schedule Estimate (49 months) based on FS estimate of 26 months for 8860 cy, 13684/8860 = 1.9, 26 x 1.9 = 49

* O&M Costs - assumed long-term fish and sediment monitoring over a 30-year period. Fish monitoring annually, sediment sampling every 5 years. Fish monitoring - $140,000 with an additional $35,000 every 5th for sediment monitoring. Present worth calculated assuming an initial cash outlay and using a discount rate of 7%, over the 30-year period as suggested by US EPA's Draft Remedy Cost Estimating Procedures Manual.

Summary of Present Worth Analysis
Alt. 3 - Middle River, Characterization, Sediment Removal & Monitoring

Year	Capital Cost	Annual O&M Cost Biota Monitoring	Annual O&M Cost Sediment Monitoring	Total Cost	Discount Factor (7%)	Present Worth
0		$140,000		$140,000	1.000	$140,000
1		$140,000		$140,000	0.935	$130,841
2		$140,000		$140,000	0.873	$122,281
3		$140,000		$140,000	0.816	$114,282
4		$140,000		$140,000	0.763	$106,805
5	$3,333,399	$140,000		$3,473,399	0.713	$2,476,486
6	$3,333,399	$140,000		$3,473,399	0.666	$2,314,473
7	$3,333,399	$140,000		$3,473,399	0.623	$2,163,058
8	$3,333,399	$140,000		$3,473,399	0.582	$2,021,550
9	$3,333,399	$140,000		$3,473,399	0.544	$1,889,299
10	$1,481,511	$140,000	$35,000	$1,656,511	0.508	$842,086
11		$140,000		$140,000	0.475	$66,513
12		$140,000		$140,000	0.444	$62,162
13		$140,000		$140,000	0.415	$58,095
14		$140,000		$140,000	0.388	$54,294
15		$140,000	$35,000	$175,000	0.362	$63,428
16		$140,000		$140,000	0.339	$47,423
17		$140,000		$140,000	0.317	$44,320
18		$140,000		$140,000	0.296	$41,421
19		$140,000		$140,000	0.277	$38,711
20		$140,000	$35,000	$175,000	0.258	$45,223
21		$140,000		$140,000	0.242	$33,812
22		$140,000		$140,000	0.226	$31,600
23		$140,000		$140,000	0.211	$29,533
24		$140,000		$140,000	0.197	$27,601
25		$140,000	$35,000	$175,000	0.184	$32,244
26		$140,000		$140,000	0.172	$24,107
27		$140,000		$140,000	0.161	$22,530
28		$140,000		$140,000	0.150	$21,056
29		$140,000		$140,000	0.141	$19,679
30		$140,000	$35,000	$175,000	0.131	$22,989
Totals	$18,148,507	$4,340,000	$175,000	$22,663,507		**$13,107,903**

Summary of Present Worth Analysis
Alt. 2 - Lower River & Inner Harbor, Natural Recovery

Year	Capital Cost	Annual O&M Cost Biota Monitoring	Sediment Monitoring	Bathymetry Survey	Breakwall Maintenance	Total Cost	Discount Factor (7%)	Present Worth
0		$25,000	$175,000	$14,000	$112,300	$326,300	1.000	$326,300
1		$25,000	$50,000	$14,000	$112,300	$201,300	0.935	$188,131
2		$25,000	$50,000	$14,000	$112,300	$201,300	0.873	$175,823
3		$25,000	$50,000	$14,000	$112,300	$201,300	0.816	$164,321
4		$25,000	$175,000	$14,000	$112,300	$326,300	0.763	$248,933
5		$25,000	$50,000	$14,000	$112,300	$201,300	0.713	$143,524
6		$25,000	$50,000	$14,000	$112,300	$201,300	0.666	$134,135
7		$25,000	$50,000	$14,000	$112,300	$201,300	0.623	$125,360
8		$25,000	$50,000	$14,000	$112,300	$201,300	0.582	$117,158
9		$25,000	$175,000	$14,000	$112,300	$326,300	0.544	$177,486
10		$25,000	$50,000	$14,000	$112,300	$201,300	0.508	$102,331
11		$25,000	$50,000	$14,000	$112,300	$201,300	0.475	$95,636
12		$25,000	$50,000	$14,000	$112,300	$201,300	0.444	$89,380
13		$25,000	$50,000	$14,000	$112,300	$201,300	0.415	$83,532
14		$25,000	$175,000	$14,000	$112,300	$326,300	0.388	$126,545
15		$25,000	$50,000	$14,000	$112,300	$201,300	0.362	$72,960
16		$25,000	$50,000	$14,000	$112,300	$201,300	0.339	$68,187
17		$25,000	$50,000	$14,000	$112,300	$201,300	0.317	$63,726
18		$25,000	$50,000	$14,000	$112,300	$201,300	0.296	$59,557
19		$25,000	$175,000	$14,000	$112,300	$326,300	0.277	$90,225
20		$25,000	$50,000	$14,000	$112,300	$201,300	0.258	$52,020
21		$25,000	$50,000	$14,000	$112,300	$201,300	0.242	$48,617
22		$25,000	$50,000	$14,000	$112,300	$201,300	0.226	$45,436
23		$25,000	$50,000	$14,000	$112,300	$201,300	0.211	$42,464
24		$25,000	$175,000	$14,000	$112,300	$326,300	0.197	$64,329
25		$25,000	$50,000	$14,000	$112,300	$201,300	0.184	$37,089
26		$25,000	$50,000	$14,000	$112,300	$201,300	0.172	$34,663
27		$25,000	$50,000	$14,000	$112,300	$201,300	0.161	$32,395
28		$25,000	$50,000	$14,000	$112,300	$201,300	0.150	$30,276
29		$25,000	$175,000	$14,000	$112,300	$326,300	0.141	$45,866
30		$25,000	$50,000	$14,000	$112,300	$201,300	0.131	$26,444
Totals	$0	$775,000	$2,425,000	$434,000	$3,481,300	$7,115,300		**$3,112,848**

SHEBOYGAN RIVER & HARBOR SUPERFUND SITE
LOWER RIVER & INNER HARBOR SEDIMENT REMOVAL
SEDIMENT TRAP

SUMMARY OF CAPITAL and O & M COST

Alternative: 3		Expected Accuracy Range:	FS: -30%/+50%
Description: Sediment Trap		Present Net Worth Discount Rate:	7.0%
Site: Sheboygan River & Harbor		Base Year of Estimate:	2000
Location: Sheboygan, WI		Capital Cost Years:	8
Date Prepared: 04/11/2000		O&M Cost Years:	1 - 30

	Description	Quantity	Unit	Unit Cost	Cost	Totals	Percent of Total Costs	Notes
	Capital Cost (Year 2008)							
1	Mobilization / Demobilization					$3,944,254		
	Construction Equipment & Facilities	1	Lump Sum		$2,300,232			
	Setup/Construct Temp Facilities	1	Lump Sum		$453,612			
	Construct Temporary Facilities	1	Lump Sum		$655,559			
	Transfer Facility Plant Erection	1	Lump Sum		$160,620			
	Remove Temporary Facilities	1	Lump Sum		$36,704			
	Remove Temporary Utilities	1	Lump Sum		$4,310			
	Construction Equipment Demobilization	1	Lump Sum		$4,437			
	Process Plant Equipment Removal	1	Lump Sum		$78,780			
	Backfilling w/clean sediments	1	Lump Sum		$250,000			
2	Monitor, Samp, Test, & Analysis					$30,201		
	Surface Water Monitoring During Dredging	1	Lump Sum	$11,693,00	$11,693			
	Sediment Monitoring During Dredging	1	Lump Sum	$18,508,00	$18,508			
3	Excavation / Collection					$166,320		
	Dredging, Transfer, Containment Area A	27,000	Cubic Yards	$6.16	$166,320			
5	Stabilization / Fixation	27,000	Cubic Yards	$50.95	$1,375,650	$1,375,650		
6	Sediment Disposal					$4,905,360		
	Container Handling/loading	27,000	Cubic Yards	$1.68	$45,360			
	Transport & disposal To An In-State Facility	27,000	Tons	$40.00	$1,080,000			sediment < 50 ppm
	Transport & Disposal To An Out-of-State Facility	27,000	Tons	$140.00	$3,780,000			sediment > 50 ppm
7	Site Restoration					$38,196		
8	Institutional Controls					$0		
	SUBTOTAL					$10,421,785		
9	Contingency			0.0%	$0	$0		
	(35% contingency included in unit cost)					$10,421,785		
	SUBTOTAL							
10	Project Management & support					$0		
	(included in unit cost)			0.0%	$0			
					$0			
	TOTAL CAPITAL COSTS					$10,421,785		
	O&M Costs *					$8,121,800		
	Biota & sediment Monitoring				$3,575,000			
	Bathymetry Survey				$504,00			
	Breakwaters Maintenance				$4,042,800			
	TOTAL CAPITAL & O&M COSTS					**$18,543,585**		
	PRESENT WORTH OF CAPITAL & O&M COSTS					**$9,286,848**		

Assumptions:

The total amount of sediment calculated for removal is 27,000 cy, but actual sediment volume will depending on harbor conditions at the time of removal.
All dredged areas would be covered with clean sediment.

Unit Costs derived from USACE: For a detailed breakout of costs see Administrative Record Update #3, Item #42. Units costs for Dredging Zone 3.

* O&M Costs - assumes annual biota monitoring @ $25,000/yr and sediment monitoring @ $50,000/yr over a 30-year period.
Sediment monitoring @ $175,000/yr every 5 years.
Annual Breakwall maintenance is estimated at $112,300/yr.
Present worth calculated assuming an initial cash outlay and using a discount rate of 7%, over the

Summary of Present Worth Analysis
Alt. 3 - Lower River & Inner Harbor, Sediment Trap

Year	Capital Cost	Annual O&M Cost Biota Monitoring	Sediment Monitoring	Bathymetry Survey	Breakwall Maintenance	Total Cost	Discount Factor (7%)	Present Worth
0		$25,000	$175,000	$14,000	$112,300	$326,300	1.000	$326,300
1		$25,000	$50,000	$14,000	$112,300	$201,300	0.935	$188,131
2		$25,000	$50,000	$14,000	$112,300	$201,300	0.873	$175,823
3		$25,000	$50,000	$14,000	$112,300	$201,300	0.816	$164,321
4		$25,000	$175,000	$14,000	$112,300	$326,300	0.763	$248,933
5		$25,000	$50,000	$14,000	$112,300	$201,300	0.713	$143,524
6		$25,000	$50,000	$14,000	$112,300	$201,300	0.666	$134,135
7		$25,000	$50,000	$14,000	$112,300	$201,300	0.623	$125,360
8	$10,421,785	$25,000	$50,000	$14,000	$112,300	$10,623,085	0.582	$6,182,732
9		$25,000	$175,000	$14,000	$112,300	$326,300	0.544	$177,486
10		$25,000	$50,000	$14,000	$112,300	$201,300	0.508	$102,331
11		$25,000	$50,000	$14,000	$112,300	$201,300	0.475	$95,636
12		$25,000	$50,000	$14,000	$112,300	$201,300	0.444	$89,380
13		$25,000	$50,000	$14,000	$112,300	$201,300	0.415	$83,532
14		$25,000	$175,000	$14,000	$112,300	$326,300	0.388	$126,545
15		$25,000	$50,000	$14,000	$112,300	$201,300	0.362	$72,960
16		$25,000	$50,000	$14,000	$112,300	$201,300	0.339	$68,187
17		$25,000	$50,000	$14,000	$112,300	$201,300	0.317	$63,726
18		$25,000	$50,000	$14,000	$112,300	$201,300	0.296	$59,557
19		$25,000	$175,000	$14,000	$112,300	$326,300	0.277	$90,225
20		$25,000	$50,000	$14,000	$112,300	$201,300	0.258	$52,020
21		$25,000	$50,000	$14,000	$112,300	$201,300	0.242	$48,617
22		$25,000	$50,000	$14,000	$112,300	$201,300	0.226	$45,436
23		$25,000	$50,000	$14,000	$112,300	$201,300	0.211	$42,464
24		$25,000	$175,000	$14,000	$112,300	$326,300	0.197	$64,329
25		$25,000	$50,000	$14,000	$112,300	$201,300	0.184	$37,089
26		$25,000	$50,000	$14,000	$112,300	$201,300	0.172	$34,663
27		$25,000	$50,000	$14,000	$112,300	$201,300	0.161	$32,395
28		$25,000	$50,000	$14,000	$112,300	$201,300	0.150	$30,276
29		$25,000	$175,000	$14,000	$112,300	$326,300	0.141	$45,866
30		$25,000	$50,000	$14,000	$112,300	$201,300	0.131	$26,444
31		$25,000	$50,000	$14,000	$112,300	$201,300	0.123	$24,714
32		$25,000	$50,000	$14,000	$112,300	$201,300	0.115	$23,097
33		$25,000	$50,000	$14,000	$112,300	$201,300	0.107	$21,586
34		$25,000	$50,000	$14,000	$112,300	$201,300	0.100	$20,174
35		$25,000	$50,000	$14,000	$112,300	$201,300	0.094	$18,854
Totals	$10,421,785	$900,000	$2,675,000	$504,000	$4,042,800	$18,543,585		**$9,286,848**

SHEBOYGAN RIVER & HARBOR SUPERFUND SITE
LOWER RIVER & INNER HARBOR SEDIMENT REMOVAL DUE TO NATURAL AND RECREATIONAL IMPACTS

SUMMARY OF CAPITAL and O&M COSTS

Alternative: 4	Expected Accuracy Range:	FS: -30%/+50%	
Description: Recreational & Natural Impact Dreding in Inner Harbor - 2ft +	Present Net Worth Discount Rate:	7.0%	
Site: Sheboygan River & Harbor Base	Base Year of Estimate:	2000	
Location: Sheboygan, WI	Capital Cost Years:	8 - 9	
Date Prepared: 04/11/2000	O&M Cost Years:	1- 30	

	Description	Quantity	Unit	Unit Cost	Cost	Totals	Percent of Total Costs	Notes
	Capital Cost (Year 2008)							
1	Mobilization / Demobilization					$4,694,254		
	Construction Equipment & Facilities	1	Lump Sum		$2,300,232			
	Setup/Construct Temp Facilities	1	Lump Sum		$453,612			
	Construct Temporary Facilities	1	Lump Sum		$655,559			
	Transfer Facility Plant Erection	1	Lump Sum		$160,620			
	Remove Temporary Facilities	1	Lump Sum		$36,704			
	Remove Temporary Utilities	1	Lump Sum		$4,310			
	Construction Equipment Demobilization	1	Lump Sum		$4,437			
	Process Plant Equipment removal	1	Lump Sum		$78,780			
	Backfilling w/clean sediment	1	Lump Sum		$1,000,000			
2	Monitor, Samp, Test, & Analysis					$64,837		
	Surface Water Monitoring During Dredging	1	Lump Sum	$25,439.00	$25,439			
	Sediment Monitoring During Dredging	1	Lump Sum	$39,398.00	$39,398			
3	Excavation / Collection					$326,560		
	Dredging, Transfer, Containment Area A	47,732	Cubic Yards	$6.16	$294,029			
	Dredging Transfer, Containment Area B	3,761	Cubic Yards	$6.16	$23,168			
	Dredging, Transfer, Containment Area C	1,520	Cubic Yards	$6.16	$9,363			
	Total Cubic Yards	53,013						
5	Stabilization / Fixation	53,013	Cubic Yards	$50.95	$2,701,012	$2,701,012		
6	Sediment Disposal					$4,330,102		
	Container Handling/Loading	53,013	Cubic Yards	$1.68	$89,062			
	Transport & Disposal To An In-State Facility	106,026	Tons	$40.00	$4,241,040			sediments < 50 ppm
	Transport & Disposal To An Out-of-State Facility	0	Tons	$140.00	$0			sediments > 50 ppm
7	Site Restoration					$38,196		
8	Institutional Controls					$0		
	SUBTOTAL					$12,116,765		
9	Contingency			0.0%	$0	$0		
	(35% contingency included in unit cost)							
	SUBTOTAL					$12,116,765		
10	Project Management & Support					$0		
	(included in unit cost)			0.0%	$0			
					$0			
	TOTAL CAPITAL COSTS					$12,116,765		
	O & M Costs *					$8,121,800		
	Biota & Sediment Monitoring				$3,575,000			
	Bathymetry Survey				$504,000			
	Breakwaters Maintenance				$4,042,800			
	TOTAL CAPITAL & O&M COSTS					**$20,238,565**		
	PRESENT WORTH OF CAPITAL & O&M COSTS					**$10,042,667**		

Assumptions:

This Inner Harbor Altnerative includes dreding 2 feet depth in Zone A (from Penn. Ave. Bridge to just past the 8th St. Bridge, then an additional foot in Zones B & C.
All dredged areas would be covered with clean sediment.

The total amount of sediment calculated for removal is 53,000 cy, but actual sediment volume will depending on harbor conditions at the time of removal.

Unit Costs derived from USACE: For a detailed breakout of costs see Administrative Record Update #3. Item #42. Units costs for Dredging Zone 2 were used which assumed removing 57,679 cy. Use of these number will result in a slight over estimate of costs.

* O&M Costs - assumes annual biota monitoring @ $25,000/yr and sediment monitoring @ $50,000/yr over a 30-year period. Sediment monitoring @ $175,000/yr every 5 years.
Annual Breakwall maintenance is estimated at $112,300/yr.
Present worth calculated assuming an initial cash outlay and using a discount rate of 7%, over the 35 years

Summary of Present Worth Analysis
Alt. 4 - Lower River & Inner Harbor, Sediment Removal Due to Natural & Recreational Impacts

Year	Capital Cost	Annual O&M Cost Biota Monitoring	Sediment Monitoring	Bathymetry Survey	Breakwall Maintenance	Total Cost	Discount Factor (7%)	Present Worth
0		$ 25,000	$175,000	$14,000	$112,300	$326,300	1.000	$326,300
1		$ 25,000	$50,000	$14,000	$112,300	$201,300	0.935	$188,131
2		$ 25,000	$50,000	$14,000	$112,300	$201,300	0.873	$175,823
3		$ 25,000	$50,000	$14,000	$112,300	$201,300	0.816	$164,321
4		$ 25,000	$175,000	$14,000	$112,300	$326,300	0.763	$248,933
5		$25,000	$50,000	$14,000	$112,300	$201,300	0.713	$143,524
6		$25,000	$50,000	$14,000	$112,300	$201,300	0.666	$134,135
7		$25,000	$50,000	$14,000	$112,300	$201,300	0.623	$125,360
8	$6,058,383	$25,000	$50,000	$14,000	$112,300	$6,259,683	0.582	$3,643,192
9	$6,058,383	$25,000	$175,000	$14,000	$112,300	$6,384,683	0.544	$3,472,844
10		$25,000	$50,000	$14,000	$112,300	$201,300	0.508	$102,331
11		$25,000	$50,000	$14,000	$112,300	$201,300	0.475	$95,636
12		$25,000	$50,000	$14,000	$112,300	$201,300	0.444	$89,380
13		$25,000	$50,000	$14,000	$112,300	$201,300	0.415	$83,532
14		$25,000	$175,000	$14,000	$112,300	$326,300	0.388	$126,545
15		$25,000	$50,000	$14,000	$112,300	$201,300	0.362	$72,960
16		$25,000	$50,000	$14,000	$112,300	$201,300	0.339	$68,187
17		$25,000	$50,000	$14,000	$112,300	$201,300	0.317	$63,726
18		$25,000	$50,000	$14,000	$112,300	$201,300	0.296	$59,557
19		$25,000	$175,000	$14,000	$112,300	$326,300	0.277	$90,225
20		$25,000	$50,000	$14,000	$112,300	$201,300	0.258	$52,020
21		$25,000	$50,000	$14,000	$112,300	$201,300	0.242	$48,617
22		$25,000	$50,000	$14,000	$112,300	$201,300	0.226	$45,436
23		$25,000	$50,000	$14,000	$112,300	$201,300	0.211	$42,464
24		$25,000	$175,000	$14,000	$112,300	$326,300	0.197	$64,329
25		$25,000	$50,000	$14,000	$112,300	$201,300	0.184	$37,089
26		$25,000	$50,000	$14,000	$112,300	$201,300	0.172	$34,663
27		$25,000	$50,000	$14,000	$112,300	$201,300	0.161	$32,395
28		$25,000	$50,000	$14,000	$112,300	$201,300	0.150	$30,276
29		$25,000	$175,000	$14,000	$112,300	$326,300	0.141	$45,866
30		$25,000	$50,000	$14,000	$112,300	$201,300	0.131	$26,444
31		$25,000	$50,000	$14,000	$112,300	$201,300	0.123	$24,714
32		$25,000	$50,000	$14,000	$112,300	$201,300	0.115	$23,097
33		$25,000	$50,000	$14,000	$112,300	$201,300	0.107	$21,586
34		$25,000	$50,000	$14,000	$112,300	$201,300	0.100	$20,174
35		$25,000	$50,000	$14,000	$112,300	$201,300	0.094	$18,854
Totals	$12,116,765	$900,000	$2,675,000	$504,000	$4,042,800	$20,238,565		**$10,042,667**

SHEBOYGAN RIVER & HARBOR SUPERFUND SITE
LOWER RIVER & INNER HARBOR SEDIMENT REMOVAL
SEDIMENT CAP

SUMMARY OF CAPITAL and O&M COSTS

Alternative: 5		Expected Accuracy Range:	FS: -30%/+50%
Description: Sediment Cap		Present Net Worth Discount Rate:	7.0%
Site: Sheboygan River & Harbor		Base Year of Estimate:	2000
Location: Sheboygan, WI		Capital Cost Years:	8
Date Prepared: 04/11/2000		O&M Cost Years:	1 - 30

	Description	Quantity	Unit	Unit Cost	Cost	Totals	Percent of Total Costs	Notes
	Capital Cost (Year 2008)							
1	Mobilization / Demobilization	1	Lump Sum	$424,000.00	$424,000	$811,200		
	Access Development	88,000	SF	$4.40	$387,200			
2	Silt Containment Barrier					$729,200		
	Material and Initial Installation	1,320	LF	$60.00	$79,200			
	Additional Set-ups/Teardowns	13	Each	$50,000.00	$650,000			
3	Geocomposite Layer Installation	1,040,000	SF	$1.95	$2,028,000	$2,028,000		
4	Sand Capping Layer					$2,221,800		
	Materials	94,000	Cubic Yards	$9.20	$864,800			
	Installation	118	Day	$11,500.00	$1,357,000			
5	Armoring Layer					$2,674,500		
	Materials	56,500	Cubic Yards	$31.00	$1,751,500			
	Installation	71	Day	$13,000.00	$923,000			
6	Monitoring					$447,040		
	Bathymetric Survey	35	Acre	$1,000.00	$35,000			
	Water Column Sampling (Labor)	18	Month	$4,950.00	$89,100			
	Analytical Expenses	1,188	Each	$255.00	$302,940			
	Other Direct Field Expenses	1	Lump Sum	$20,000.00	$20,000			
	SUBTOTAL					$8,911,740		
7	Engineering Design			7.0%	$623,822	$623,822		
8	Construction Management			10.0%	$891,174	$891,174		
9	Contingency			25.0%	$2,450,729	$2,450,729		
	TOTAL CAPITAL COSTS					$12,877,464		
	O & M Costs *					$7,881,300		
	Biota & Sediment Monitoring				$3,200,000			
	Breakwaters Maintenance				$3,481,300			
	Cap Maintenance				$1,200,000			
	TOTAL CAPITAL & O&M COSTS					**$20,758,764**		
	PRESENT WORTH OF CAPITAL & O&M COSTS					**$10,760,933**		

Assumptions:

Capital Costs Derived From FS Assumptions

* O&M Costs - assumes annual biota monitoring @ $25,000/yr and sediment monitoring @ $50,000/yr over a 30-year period.
Sediment monitoring @ $175,000/yr every 5 years.
Annual Breakwall maintenance is estimated at $112,300/yr. Cap Maintenance is estimated to be $300,000 every 5 years.

Present worth calculated assuming an initial cash outlay and using a discount rate of 7%, over the 35 years

Summary of Present Worth Analysis
Alt. 5 - Lower River & Inner Harbor, Sediment Cap

Year	Capital Cost	Annual O&M Cost Biota Monitoring	Sediment Monitoring	Cap Maintenance	Breakwall Maintenance	Total Cost	Discount Factor (7%)	Present Worth
0		$ 25,000	$175,000		$112,300	$312,300	1.000	$312,300
1		$ 25,000	$50,000		$112,300	$187,300	0.935	$175,047
2		$ 25,000	$50,000		$112,300	$187,300	0.873	$163,595
3		$ 25,000	$50,000		$112,300	$187,300	0.816	$152,893
4		$ 25,000	$175,000		$112,300	$312,300	0.763	$238,252
5		$25,000	$50,000		$112,300	$187,300	0.713	$133,542
6		$25,000	$50,000		$112,300	$187,300	0.666	$124,806
7		$25,000	$50,000		$112,300	$187,300	0.623	$116,641
8	$12,877,464	$25,000	$50,000		$112,300	$13,064,764	0.582	$7,603,812
9		$25,000	$175,000		$112,300	$312,300	0.544	$169,871
10		$25,000	$50,000		$112,300	$187,300	0.508	$95,214
11		$25,000	$50,000		$112,300	$187,300	0.475	$88,985
12		$25,000	$50,000	$300,000	$112,300	$487,300	0.444	$216,367
13		$25,000	$50,000		$112,300	$187,300	0.415	$77,723
14		$25,000	$175,000		$112,300	$312,300	0.388	$121,115
15		$25,000	$50,000		$112,300	$187,300	0.362	$67,886
16		$25,000	$50,000		$112,300	$187,300	0.339	$63,445
17		$25,000	$50,000	$300,000	$112,300	$487,300	0.317	$154,267
18		$25,000	$50,000		$112,300	$187,300	0.296	$55,415
19		$25,000	$175,000		$112,300	$312,300	0.277	$86,354
20		$25,000	$50,000		$112,300	$187,300	0.258	$48,402
21		$25,000	$50,000		$112,300	$187,300	0.242	$45,235
22		$25,000	$50,000	$300,000	$112,300	$487,300	0.226	$109,990
23		$25,000	$50,000		$112,300	$187,300	0.211	$39,510
24		$25,000	$175,000		$112,300	$312,300	0.197	$61,569
25		$25,000	$50,000		$112,300	$187,300	0.184	$34,510
26		$25,000	$50,000		$112,300	$187,300	0.172	$32,252
27		$25,000	$50,000		$112,300	$187,300	0.161	$30,142
28		$25,000	$50,000	$300,000	$112,300	$487,300	0.150	$73,291
29		$25,000	$175,000		$112,300	$312,300	0.141	$43,898
30		$25,000	$50,000		$112,300	$187,300	0.131	$24,605
Totals	$12,877,464	$775,000	$2,425,000	$1,200,000	$3,481,300	$20,758,764		**$10,760,933**

SHEBOYGAN RIVER & HARBOR SUPERFUND SITE
LOWER RIVER & INNER HARBOR SEDIMENT REMOVAL
SURFACE SEDIMENT REMOVAL

SUMMARY OF CAPITAL and O&M COSTS

Alternative: 6		Expected Accuracy Range:	FS: -30%/+50%
Description: Surface Sediment Removal		Present Net Worth Discount Rate:	7.0%
Site: Sheboygan River & Harbor		Base Year of Estimate:	2000
Location: Sheboygan, WI		Capital Cost Years:	8 - 11
Date Prepared: 04/11/2000		O&M Cost Years:	1 - 30

	Description	Quantity	Unit	Unit Cost	Cost	Totals	Percent of Total Costs	Notes
	Capital Cost (Year 2008)							
1	Mobilization / Demobilization					$5,194,254		
	Construction Equipment & Facilities	1	Lump Sum		$2,300,232			
	Setup/Construct Temp Facilities	1	Lump Sum		$453,612			
	Construct Temporary Facilities	1	Lump Sum		$655,559			
	Transfer Facility Plant Erection	1	Lump Sum		$160,620			
	Remove Temporary Facilities	1	Lump Sum		$36,704			
	Remove Temporary Utilities	1	Lump Sum		$4,310			
	Construction Equipment Demobilization	1	Lump Sum		$4,437			
	Process Plant Equipment Removal	1	Lump Sum		$78,780			
	Backfilling w/clean sediment	1	Lump Sum		$1,500,000			
2	Monitor, Samp, Test, & Analysis					$129,674		
	Surface Water Monitoring During Dredging	1	Lump Sum	$50,878.00	$50,878			
	Sediment Monitoring During Dredging	1	Lump Sum	$78,796.00	$78,796			
3	Excavation / Collection					$720,720		
	Dredging, Transfer, Containment Area A	117,000	Cubic Yards	$6.16	$720,720			
5	Stabilization / Fixation	117,000	Cubic Yards	$50.95	$5,961,150	$5,961,150		
6	Sediment Disposal					$9,556,560		
	Container Handling/Loading	117,000	Cubic Yards	$1.68	$196,560			
	Transport & Disposal To An In-State Facility	234,000	Tons	$40.00	$9,360,000			sediments < 50 ppm
	Transport & Disposal To An Out-of-State Facility	0	Tons	$140.00	$0			sediments > 50 ppm
7	Site Restoration					$38,196		
8	Institutional Controls					$0		
	SUBTOTAL					$21,562,358		
9	Contingency			0.0%	$0	$0		
	(35% contingency included in unit cost)							
	SUBTOTAL					$21,562,358		
10	Project Management & Support					$0		
	(included in unit cost)			0.0%	$0			
					$0			
	TOTAL CAPITAL COSTS					$21,562,358		
	O & M Costs *					$8,121,800		
	Biota & Sediment Monitoring				$3,575,000			
	Bathymetry Survey				$504,000			
	Breakwaters Maintenance				$4,042,800			
	TOTAL CAPITAL & O&M COSTS					**$29,684,158**		
	PRESENT WORTH OF CAPITAL & O&M COSTS					**$14,592,103**		

Assumptions:

The total amount of sediment calculated for removal is 117,000 cy, but actual sediment volume will depending on harbor conditions at the time of removal.
All dredged areas would be covered with clean sediment.

Unit Costs derived from USACE: For a detailed breakout of costs see Administrative Record Update #3. Item #42. Units costs for Dredging Zone 2 times two.

* O&M Costs - assumes annual biota monitoring @ $25,000/yr and sediment monitoring @ $50,000/yr over a 30-year period. Sediment monitoring @ $175,000/yr every 5 years.
Annual Breakwall maintenance is estimated at $112,300/yr.
Present worth calculated assuming an initial cash outlay and using a discount rate of 7%, over the 35 years

Summary of Present Worth Analysis
Alt. 6 - Lower River & Inner Harbor, Inner Harbor Surface Sediment Removal

Year	Capital Cost	Annual O&M Cost Biota Monitoring	Sediment Monitoring	Bathymetry Survey	Breakwall Maintenance	Total Cost	Discount Factor (7%)	Present Worth
0		$ 25,000	$175,000	$14,000	$112,300	$326,300	1.000	$326,300
1		$ 25,000	$50,000	$14,000	$112,300	$201,300	0.935	$188,131
2		$ 25,000	$50,000	$14,000	$112,300	$201,300	0.873	$175,823
3		$ 25,000	$50,000	$14,000	$112,300	$201,300	0.816	$164,321
4		$ 25,000	$175,000	$14,000	$112,300	$326,300	0.763	$248,933
5		$25,000	$50,000	$14,000	$112,300	$201,300	0.713	$143,524
6		$25,000	$50,000	$14,000	$112,300	$201,300	0.666	$134,135
7		$25,000	$50,000	$14,000	$112,300	$201,300	0.623	$125,360
8	$5,390,590	$25,000	$50,000	$14,000	$112,300	$5,591,890	0.582	$3,254,531
9	$5,390,590	$25,000	$175,000	$14,000	$112,300	$5,716,890	0.544	$3,109,609
10	$5,390,590	$25,000	$50,000	$14,000	$112,300	$5,591,890	0.508	$2,842,633
11	$5,390,590	$25,000	$50,000	$14,000	$112,300	$5,591,890	0.475	$2,656,666
12		$25,000	$50,000	$14,000	$112,300	$201,300	0.444	$89,380
13		$25,000	$50,000	$14,000	$112,300	$201,300	0.415	$83,532
14		$25,000	$175,000	$14,000	$112,300	$326,300	0.388	$126,545
15		$25,000	$50,000	$14,000	$112,300	$201,300	0.362	$72,960
16		$25,000	$50,000	$14,000	$112,300	$201,300	0.339	$68,187
17		$25,000	$50,000	$14,000	$112,300	$201,300	0.317	$63,726
18		$25,000	$50,000	$14,000	$112,300	$201,300	0.296	$59,557
19		$25,000	$175,000	$14,000	$112,300	$326,300	0.277	$90,225
20		$25,000	$50,000	$14,000	$112,300	$201,300	0.258	$52,020
21		$25,000	$50,000	$14,000	$112,300	$201,300	0.242	$48,617
22		$25,000	$50,000	$14,000	$112,300	$201,300	0.226	$45,436
23		$25,000	$50,000	$14,000	$112,300	$201,300	0.211	$42,464
24		$25,000	$175,000	$14,000	$112,300	$326,300	0.197	$64,329
25		$25,000	$50,000	$14,000	$112,300	$201,300	0.184	$37,089
26		$25,000	$50,000	$14,000	$112,300	$201,300	0.172	$34,663
27		$25,000	$50,000	$14,000	$112,300	$201,300	0.161	$32,395
28		$25,000	$50,000	$14,000	$112,300	$201,300	0.150	$30,276
29		$25,000	$175,000	$14,000	$112,300	$326,300	0.141	$45,866
30		$25,000	$50,000	$14,000	$112,300	$201,300	0.131	$26,444
31		$25,000	$50,000	$14,000	$112,300	$201,300	0.123	$24,714
32		$25,000	$50,000	$14,000	$112,300	$201,300	0.115	$23,097
33		$25,000	$50,000	$14,000	$112,300	$201,300	0.107	$21,586
34		$25,000	$50,000	$14,000	$112,300	$201,300	0.100	$20,174
35		$25,000	$50,000	$14,000	$112,300	$201,300	0.094	$18,854
Totals	$21,562,358	$900,000	$2,675,000	$504,000	$4,042,800	$29,684,158		**$14,592,103**

SHEBOYGAN RIVER AND HARBOR
FEASIBILITY STUDY REPORT

LOWER RIVER AND HARBOR SEDIMENT - INNER HARBOR SEDIMENT REMOVAL

Mechanical removal of 960,000 cy of sediment from the Lower River and Inner Harbor

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT PRICE	ESTIMATED COST
1	Mobilization/Demobilization	1	LS	5%	$5,437,000
2	Coring and Sounding Program (pre-construction)	1	LS	$300,000	$300,000
3	Silt Containment Barrier – Material and Initial Installation – Additional Set-ups/Teardowns	11,000 20	LF EA	$60 $50,000	$660,000 $1,000,000
4	Access Area Development Improvements to C. Reiss Coal Property & Modification to Docking Facilities	175,000	SF	$4.40	$770,000
5	Mechanical Dredging – Mob/demob of Dredger and Support (annual) – Dredging Operations	8 960,000	YR CY	$40,000 $40	$320,000 $38,400,000
6	Water Transport/Off-loading of Dredgings	1,084,800	CY	$20	$21,696,000
7	Monitoring During Open Water Dredging	55	MO	$40,000	$2,200,000
8	Dewatering/Stabilization Operations – System Purchase – Process Operations (excluding labor) – Materials (cement kiln dust) – Labor Support for on-land operations	1 1,084,800 292,900 55	LS CY TON MO	$500,000 $20 $20 $37,500	$500,000 $21,696,000 $5,858,000 $2,062,500
9	Water Treatment System – Package Treatment Plant – System Operations & Maintenance	1 55	LS MO	$500,000 $16,000	$500,000 $880,000
10	Loadout of Dewatered Sediments	1,218,400	CY	$10	$12,184,000
11	Portable Truck Scale Purchase	1	LS	$30,000	$30,000
12	Transportation and off-site Disposal – non-TSCA Sediments – TSCA Sediments	879,050 879,050	TON TON	$40 $140	$35,162,000 $123,067,000
	SUBTOTAL=				$272,722,500
13	Engineering/ Design	7%			$8,015,000
14	Construction Management	55	MO	$60,000	$3,300,000
15	Contingency	20%			$55,205,000
	TOTAL CAPITAL COSTS=				$339,242,500
16	Operations & Maintenance			$4,384,500	
	TOTAL ALTERNATIVE=			$343,627,000	
	NET PRESENT WORTH OF CAPITAL/O & M =			$169,313,455	

Summary of Present Worth Analysis
Alt.7 - Lower River & Inner Harbor, Complete Excavation

Year	Capital Cost	Annual O&M Cost Biota & Sediment Monitoring	Breakwall Maintenance	Total Cost	Discount Factor (7%)	Present Worth
0		$75,000	$112,300	$187,300	1.000	$187,300
1		$75,000	$112,300	$187,300	0.935	$175,047
2		$75,000	$112,300	$187,300	0.873	$163,595
3		$75,000	$112,300	$187,300	0.816	$152,893
4		$75,000	$112,300	$187,300	0.763	$142,890
5		$75,000	$112,300	$187,300	0.713	$133,542
6		$75,000	$112,300	$187,300	0.666	$124,806
7		$75,000	$112,300	$187,300	0.623	$116,641
8	$55,512,409	$75,000	$112,300	$55,699,709	0.582	$32,417,738
9	$55,512,409	$75,000	$112,300	$55,699,709	0.544	$30,296,951
10	$55,512,409	$75,000	$112,300	$55,699,709	0.508	$28,314,908
11	$55,512,409	$75,000	$112,300	$55,699,709	0.475	$26,462,531
12	$55,512,409	$75,000	$112,300	$55,699,709	0.444	$24,731,337
13	$55,512,409	$75,000	$112,300	$55,699,709	0.415	$23,113,399
14	$6,168,045	$75,000	$112,300	$6,355,345	0.388	$2,464,713
15		$75,000		$75,000	0.362	$27,183
16		$75,000		$75,000	0.339	$25,405
17		$75,000		$75,000	0.317	$23,743
18		$75,000		$75,000	0.296	$22,190
19		$75,000		$75,000	0.277	$20,738
20		$75,000		$75,000	0.258	$19,381
21		$75,000		$75,000	0.242	$18,113
22		$75,000		$75,000	0.226	$16,928
23		$75,000		$75,000	0.211	$15,821
24		$75,000		$75,000	0.197	$14,786
25		$75,000		$75,000	0.184	$13,819
26		$75,000		$75,000	0.172	$12,915
27		$75,000		$75,000	0.161	$12,070
28		$75,000		$75,000	0.150	$11,280
29		$75,000		$75,000	0.141	$10,542
30		$75,000		$75,000	0.131	$9,853
31		$75,000		$75,000	0.123	$9,208
32		$75,000		$75,000	0.115	$8,606
33		$75,000		$75,000	0.107	$8,043
34		$75,000		$75,000	0.100	$7,516
35		$75,000		$75,000	0.094	$7,025
Totals	$339,242,500	$2,700,000	$1,684,500	$343,627,000		**$169,313,455**

Assumptions: Construction expected 9 out of 12 months each year.

Capital Costs Obtained from Feasibility Study and Timephase Based on Project Duration - 55 months

SHEBOYGAN RIVER AND HARBOR
FEASIBILITY STUDY REPORT

FLOODPLAIN BANK SOIL - BANK SOIL STABILIZATION

Modification/improvements to approximately 900 feet of River bank in the Upper River

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT PRICE	ESTIMATED COST
1	Mobilization/Demobilization	1	L.S.	$30,000	$30,000
2	Access Area Development/Restoration	10,000	SF	$4.40	$44,000
3	Access Road Development	1,000	LF	$13	$13,000
4	Clear/Grub Woods Area-Site Prep	0.4	ACRE	$16,800	$6,720
5	Remove 12 inches of Bank Soil/Regrade	670	CY	$20	$13,400
6	Transport\Transfer River Bank Soil	670	CY	$110	$73,700
7	Place Geotextile on Regraded Bank	2,000	SY	$2.10	$4,200
8	Place Rip-Rap/Natural Plantings on River Bank	2,000	SY	$36	$72,000
9	Seeding/Revegetation	17,400	SF	$0.10	$1,740
10	Load Soil onto 20 ton truck	740	CY	$10	$7,400
11	Soil Analysis for Disposal (1 every 200 CY)	4	EA	$120	$480
12	Transport and Offsite (TSCA Landfill) Disposal	888	TON	$140	$124,320
13	Access Road Removal/Restoration	1,000	LF	$6.50	$6,500
14	Other Restoration Costs	1	L.S.	$25,000	$25,000
	SUBTOTAL=				$422,460
15	Engineering/ Design	15%			$63,400
16	Construction Management	10%			$42,200
17	Contingency	25%			$116,200
	TOTAL CAPITAL COSTS=				$644,260
18	Operations & Maintenance			$174,000	
	TOTAL ALTERNATIVE=			$818,260	
	NET PRESENT WORTH OF CAPITAL & O&M			$631,568	

Summary of Present Worth Analysis
Floodplain / Bank Soil - Bank Stabilization

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (7%)	Present Worth
0			$0	1.000	$0
1			$0	0.935	$0
2	$644,260	$6,000	$650,260	0.873	$567,962
3		$6,000	$6,000	0.816	$4,898
4		$6,000	$6,000	0.763	$4,577
5		$6,000	$6,000	0.713	$4,278
6		$6,000	$6,000	0.666	$3,998
7		$6,000	$6,000	0.623	$3,736
8		$6,000	$6,000	0.582	$3,492
9		$6,000	$6,000	0.544	$3,264
10		$6,000	$6,000	0.508	$3,050
11		$6,000	$6,000	0.475	$2,851
12		$6,000	$6,000	0.444	$2,664
13		$6,000	$6,000	0.415	$2,490
14		$6,000	$6,000	0.388	$2,327
15		$6,000	$6,000	0.362	$2,175
16		$6,000	$6,000	0.339	$2,032
17		$6,000	$6,000	0.317	$1,899
18		$6,000	$6,000	0.296	$1,775
19		$6,000	$6,000	0.277	$1,659
20		$6,000	$6,000	0.258	$1,551
21		$6,000	$6,000	0.242	$1,449
22		$6,000	$6,000	0.226	$1,354
23		$6,000	$6,000	0.211	$1,266
24		$6,000	$6,000	0.197	$1,183
25		$6,000	$6,000	0.184	$1,105
26		$6,000	$6,000	0.172	$1,033
27		$6,000	$6,000	0.161	$966
28		$6,000	$6,000	0.150	$902
29		$6,000	$6,000	0.141	$843
30		$6,000	$6,000	0.131	$788
Totals	$644,260	$174,000	$818,260		**$631,568**

SHEBOYGAN RIVER HARBOR
FEASIBILITY STUDY REPORT

GROUND WATER COLLECTION TRENCH AND TREATMENT

Installation of ground-water collection trench and treatment of recovered ground water at existing CWTF.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT PRICE	ESTIMATED COST
1	Mobilization/Demobilization	1	LS	$40,000	$40,00
2	Subsurface Site Investigation	1	LS	$115,000	$115,000
3	Source Mitigation and Control	1	LS	$100,000	$100,000
4	Site Survey/Layout/Trench Controls	10	DAY	$680	$6,800
5	Steel Sheet Piling	9,100	SF	$35	$318,500
6	Trench Excavation	1,335	CY	$3.50	$4.670
7	Trench Box Rental	2	MO	$2,500	$5,000
8	Load Soil onto Trucks	1,470	CY	$10	$14,700
9	Soil Analysis for Disposal (1 test/200 cy)	7	EA	$120	$840
10	Soil Transport and Dispose (non-TSCA)	2,205	TON	$40	$88,200
11	Trench Dewatering & Pump to CWTF	30	DAY	$620	$18,600
12	Geotextile (Materials & Installation)	3,500	SY	$2.10	$7,350
13	8th HDPE Pipe (Materials & Installation)	425	LF	$43	$16,280
14	Manhole/Sump (Materials & Installation)	1	LF	$6,200	$6,200
15	Drainage Material (Washed 3/4" Stone)	500	CY	$32	$16,000
16	Clay Backfill (3.5' bgs to grade)	170	CY	$11.50	$1,960
17	Common Fill Backfill and Compact	1,120	CY	$10	$11,200
18	Gravel Cover	450	SY	$10	$4,500
19	Sump Pump (Materials & Installation)	1	LS	$1,150	$1,150
20	Excavate Trench for Pipe Installation	70	CY	$5.20	3260
21	Piping to CWTF	160	LF	$22	$3,520
22	Retrofit of existing CWTF	1	LS	$100,000	$100,000
23	Drill Rig - Mobilization/Demobilization	1	LS	$5,000	$5,000
24	Well/Plezometer Materials	75	LF	$12	$900
	SUBTOTAL=				$888,730
25	Engineering/Design	10%			$890,000
26	Construction Management	10%			$88,900
27	Contingency	25%			$244,400
	TOTAL CAPITAL COSTS=				$1,302,030
28	Operation & Maintenance				496.135
	TOTAL ALTERNATIVE=				1,528,165

Summary of Present Worth Analysis
Groundwater - Collection Trench and Treatment

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (7%)	Present Worth
0	$1,032,030	$37,000	$1,069,030	1.000	$1,069,030
1		$37,000	$37,000	0.935	$34,579
2		$37,000	$37,000	0.873	$32,317
3		$37,000	$37,000	0.816	$30,203
4		$37,000	$37,000	0.763	$28,227
5		$37,000	$37,000	0.713	$26,380
6		$37,000	$37,000	0.666	$24,655
7		$37,000	$37,000	0.623	$23,042
8		$37,000	$37,000	0.582	$21,534
9		$37,000	$37,000	0.544	$20,126
10		$37,000	$37,000	0.508	$18,809
11		$37,000	$37,000	0.475	$17,578
12		$37,000	$37,000	0.444	$16,428
13		$37,000	$37,000	0.415	$15,354
14		$37,000	$37,000	0.388	$14,349
15		$37,000	$37,000	0.362	$13,411
16		$37,000	$37,000	0.339	$12,533
17		$37,000	$37,000	0.317	$11,713
18		$37,000	$37,000	0.296	$10,947
19		$37,000	$37,000	0.277	$10,231
20		$37,000	$37,000	0.258	$9,562
21		$37,000	$37,000	0.242	$8,936
22		$37,000	$37,000	0.226	$8,351
23		$37,000	$37,000	0.211	$7,805
24		$37,000	$37,000	0.197	$7,294
25		$37,000	$37,000	0.184	$6,817
26		$37,000	$37,000	0.172	$6,371
27		$37,000	$37,000	0.161	$5,954
28		$37,000	$37,000	0.150	$5,565
29		$37,000	$37,000	0.141	$5,201
30		$37,000	$37,000	0.131	$4,861
Totals	$1,032,030	$1,147,000	$2,179,030		**$1,528,165**

SHEBOYGAN RIVER HARBOR
FEASIBILITY STUDY REPORT

GROUND WATER - FACILITY PERIMETER OUT-OFF WALL

Installation of perimeter sheet pile cutoff wall/pumping to maintain hydraulic gradient capping of infiltration zones

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT PRICE	ESTIMATED COST
1	Mobilization/Demobilization	1	L.S.	5%	$89,550
2	Subsurface Site Investigation	1	LS	$115,000	$115,000
3	Source Mitigation and Control	1	LS	$100,000	$100,000
4	Site Survey/Layout/Wall Controls	30	DAY	$680	$20,400
5	Clearing & Stripping Topsoil	97,500	SF	$0.05	$4,875
6	Steel Sheet Piling	40,000	SF	$35	$1,400,000
7	Low permeability Cover Material	3,300	CY	$11.50	$37,950
8	Vegetative Cover	97,500	SF	$0.55	$53,625
9	Storm Water Diversion Systems	1	LS	$100,000	$100,000
10	Restoration of Parking Lot	1,100	SY	$10	$11,000
11	Well Pumps (Materials & Installation)	5	LS	$1,150	$5,750
12	Secure, In-ground Wells Vaults	5	EA	$3,510	$17,550
13	Excavate Trench for Pipe Installation	335	CY	$5.30	$1,780
14	Piping to CWTF	800	LF	$22	$17,600
15	Retrofit of existing CWTF	1	LS	$100,000	$100,000
16	Drill Rig - Mobilization/Demobilization/Drilling	1	LS	$15,000	$15,000
17	Well/Plezometer Materials	450	LF	$12	$5,400
	SUBTOTAL=				$2,095,480
18	Engineering/Design	10%			$209,500
19	Construction Management	10%			$209,500
20	Contingency	25%			$576,200
	TOTAL CAPITAL COSTS=				$3,090,680
21	Operations & Maintenance				496,135
	TOTAL ALTERNATIVE=				3,586,815

Summary of Present Worth Analysis
Groundwater - Facility Perimeter Cut-off Wall

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (7%)	Present Worth
0	$3,090,680	$37,000	$3,127,680	1.000	$3,127,680
1		$37,000	$37,000	0.935	$34.579
2		$37,000	$37,000	0.873	$32.317
3		$37,000	$37,000	0.816	$30,203
4		$37,000	$37,000	0.763	$28,227
5		$37,000	$37,000	0.713	$26,380
6		$37,000	$37,000	0.666	$24,655
7		$37,000	$37,000	0.623	$23,042
8		$37,000	$37,000	0.582	$21,534
9		$37,000	$37,000	0.544	$20,126
10		$37,000	$37,000	0.508	$18,809
11		$37,000	$37,000	0.475	$17,578
12		$37,000	$37,000	0.444	$16,428
13		$37,000	$37,000	0.415	$15,354
14		$37,000	$37,000	0.388	$14,349
15		$37,000	$37,000	0.362	$13,411
16		$37,000	$37,000	0.339	$12,533
17		$37,000	$37,000	0.317	$11,713
18		$37,000	$37,000	0.296	$10,947
19		$37,000	$37,000	0.277	$10,231
20		$37,000	$37,000	0.258	$9,562
21		$37,000	$37,000	0.242	$8,936
22		$37,000	$37,000	0.226	$8,351
23		$37,000	$37,000	0.211	$7,805
24		$37,000	$37,000	0.197	$7,294
25		$37,000	$37,000	0.184	$6,817
26		$37,000	$37,000	0.172	$6,371
27		$37,000	$37,000	0.161	$5,954
28		$37,000	$37,000	0.150	$5,565
29		$37,000	$37,000	0.141	$5,201
30		$37,000	$37,000	0.131	$4,861
Totals	$3,090,680	$1,147,000	$4,237,680		**$3,586,815**

SHEBOYGAN RIVER AND HARBOR
FEASIBILITY STUDY REPORT

GROUND WATER - INVESTIGATION/ NATURAL ATTENUATION/SOURCE IDENTIFICATION AND CONTROL

Additional subsurface investigation/potential source control and long-term natural attenuation.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT PRICE	ESTIMATED COST
1	Subsurface and Source Investigation	1	LS	$115,000	$115,000
2	Installation of New Monitoring Wells -- Drill Rig Mob/Demob & Installation -- Well Materials	 1 75	 LS LF	 $5,000 $12	 $5,000 $900
3	Source Mitigation and Control	1	LS	$100,000	$100,000
	SUBTOTAL=				$220,900
4	Engineering/Design	10%			$22,000
5	Construction Management	1	MO	$15,000	$15,000
6	Contingency	25%			$55,000
	TOTAL CAPITAL COSTS=				$312,9000
7	30-Year Monitoring (Present Worth) -- Semi-annual Ground-Water Sampling -- Laboratory Analysis -- Annual Biological Characterization -- Annual Reporting Subtotal Annual O&M	 1 1 1 1	 YRLY YRLY YRLY YRLY	 $9,000 $5,000 $2,000 $5,000 $21,000	281,590
	TOTAL ALTERNATIVE=				594,490

Summary of Present Worth Analysis
Groundwater - Investigation/Source Identification and Control

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (7%)	Present Worth
0	$312,900	$21,000	$333,900	1.000	$333,900
1		$21,000	$21,000	0.935	$19,626
2		$21,000	$21,000	0.873	$18,342
3		$21,000	$21,000	0.816	$17,142
4		$21,000	$21,000	0.763	$16,021
5		$21,000	$21,000	0.713	$14,973
6		$21,000	$21,000	0.666	$13,993
7		$21,000	$21,000	0.623	$13,078
8		$21,000	$21,000	0.582	$12,222
9		$21,000	$21,000	0.544	$11,423
10		$21,000	$21,000	0.508	$10,675
11		$21,000	$21,000	0.475	$9,977
12		$21,000	$21,000	0.444	$9,324
13		$21,000	$21,000	0.415	$8,714
14		$21,000	$21,000	0.388	$8,144
15		$21,000	$21,000	0.362	$7,611
16		$21,000	$21,000	0.339	$7,113
17		$21,000	$21,000	0.317	$6,648
18		$21,000	$21,000	0.296	$6,213
19		$21,000	$21,000	0.277	$5,807
20		$21,000	$21,000	0.258	$5,427
21		$21,000	$21,000	0.242	$5,072
22		$21,000	$21,000	0.226	$4,740
23		$21,000	$21,000	0.211	$4,430
24		$21,000	$21,000	0.197	$4,140
25		$21,000	$21,000	0.184	$3,869
26		$21,000	$21,000	0.172	$3,616
27		$21,000	$21,000	0.161	$3,380
28		$21,000	$21,000	0.150	$3,158
29		$21,000	$21,000	0.141	$2,952
30		$21,000	$21,000	0.131	$2,759
Totals	$312,900	$651,000	$963,900		**$594,490**

SHEBOYGAN RIVER HARBOR
FEASIBILITY STUDY REPORT

FLOODPLAIN SOIL REMOVAL OF SOIL WITH > 55 PPM

Excavation and Disposal of floodplain soil from Areas FPL-4 FPR-6 and FPL-11

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT PRICE	ESTIMATED COST
1	Mobilization/Demobilization	1	LS	$40,000	$40,000
2	Pre-remedial Sampling	1	LS	$100,000	$100,000
3	Clear/Grub Woods Area-Site Prep	3.15	ACRE	$16,800	$52,920
4	Remove 6 Inches of topsoil	2,563	CY	$8	$20,500
5	Access Road Construction/Maintenance	7,000	LF	$13	$91,000
6	Transfer Soil/Cross River/Unload (FPR areas)	1,191	CY	$35	$41,690
7	Load Topsoil/Debris onto 20 ton truck	2,820	CY	$10	$28,200
8	Soil Analysis for Disposal (1 every 200 CY)	14	EA	$120	$1,680
9	Transport and Offsite (WI Landfill) Disposal	790	TON	$40	$31,600
10	Transport and Offsite (TSCA Landfill) Disposal	3,380	TON	$140	$473,200
11	Misc. Site Preparation (utilities, FPL-11 access, etc.)	1	L.S.	$105,000	$105,000
12	Purchase Topsoil (6")	2,820	CY	$10	$28,200
13	Spread Topsoil (6-inch lift)	137,000	SQ. FT.	$0.50	$68,500
14	Hydroseed w/Mulch and Fertilizer	137,000	SQ. FT.	$0.05	$6,850
15	Riverbank Restoration	1,330	SY	$20	$26,600
16	Replace Trees	3.15	ACRE	$30,000	$94,500
17	Access Road Removal/Restoration	7,000	LF	$6.50	$45,500
18	Other Restoration Costs	1	L.S.	$43,000	$43,000
	SUBTOTAL=				$1,298,940
19	Engineering/Design	15%			$119,100
20	Construction Management	10%			$129,900
21	Contingency	25%			$357,200
	TOTAL CAPITAL COSTS=				$1,905,140
22	Operations & Maintenance				$452,400
	TOTAL ALTERNATIVE=				$2,357,540
	NET PRESENT WORTH OF CAPITAL/O&M COSTS				$1,843,025

Summary of Present Worth Analysis Floodplain / Bank Soil - Removal of Soil With > 50 ppm					
Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (7%)	Present Worth
0			$0	1.000	$0
1			$0	0.935	$0
2	$1,905,140	$15,600	$1,920,740	0.873	$1,677,649
3		$15,600	$15,600	0.816	$12,734
4		$15,600	$15,600	0.763	$11,901
5		$15,600	$15,600	0.713	$11,123
6		$15,600	$15,600	0.666	$10,395
7		$15,600	$15,600	0.623	$9,715
8		$15,600	$15,600	0.582	$9,079
9		$15,600	$15,600	0.544	$8,485
10		$15,600	$15,600	0.508	$7,930
11		$15,600	$15,600	0.475	$7,411
12		$15,600	$15,600	0.444	$6,927
13		$15,600	$15,600	0.415	$6,473
14		$15,600	$15,600	0.388	$6,050
15		$15,600	$15,600	0.362	$5,654
16		$15,600	$15,600	0.339	$5,284
17		$15,600	$15,600	0.317	$4,939
18		$15,600	$15,600	0.296	$4,615
19		$15,600	$15,600	0.277	$4,314
20		$15,600	$15,600	0.258	$4,031
21		$15,600	$15,600	0.242	$3,768
22		$15,600	$15,600	0.226	$3,521
23		$15,600	$15,600	0.211	$3,291
24		$15,600	$15,600	0.197	$3,075
25		$15,600	$15,600	0.184	$2,874
26		$15,600	$15,600	0.172	$2,686
27		$15,600	$15,600	0.161	$2,511
28		$15,600	$15,600	0.150	$2,346
29		$15,600	$15,600	0.141	$2,193
30		$15,600	$15,600	0.131	$2,049
Totals	$1,905,140	$452,400	$2,357,540		**$1,843,025**

SHEBOYGAN RIVER HARBOR
FEASIBILITY STUDY REPORT

FLOODPLAIN SOIL - REMOVAL OF SOIL WITH > 10 PPM

Excavation and Disposal of floodplain soil from Areas FPR-3, FPL-4, FPR-5, FPR-6, FPR-7, FPL-8, and FPL-11

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNITS	UNIT PRICE	ESTIMATED COST
1	Mobilization/Demobilization	1	L.S.	$98,700	$98,700
2	Pre-remedial Sampling	1	LS	$100,000	$100,000
3	Clear/Grub Woods Area-Site Prep	13.40	ACRE	$16,800	$225,120
4	Remove 6 Inches of topsoil	10,797	CY	$8	$86,380
5	Access Road Construction/Maintenance	9,600	LF	$13	$124,800
6	Transfer Soil/Cross River/Unload (FPR areas)	7,109	CY	$35	$248,820
7	Load Topsoil/Debris onto 20 ton truck	11,880	CY	$10	$118,800
8	Soil Analysis for Disposal (1 every 200 CY)	61	EA	$120	$7,320
9	Transport and Offsite (WI Landfill) Disposal	14,230	TON	$40	$569,200
10	Transport and Offsite (TSCA Landfill) Disposal	3,380	TON	$140	$473,200
11	Misc. Site Preparation (utilities, FPL-11 access, etc.)	1	L.S.	$105,000	$105,000
12	Purchase Topsoil (6")	11,880	CY	$10	$118,800
13	Spread Topsoil (6-inch lift)	584,000	SQ. FT.	$0.50	$292,000
14	Hydroseed w/Mulch and Fertilizer	584,000	SQ. FT.	$0.05	$29,200
15	Riverbank Restoration	5,500	SY	$20	$110,000
16	Replace Trees	13.40	ACRE	$30,000	$402,200
17	Access Road Removal/Restoration	9,600	LF	$6.50	$62,400
18	Other Restoration Costs	1	L.S.	$43,000	$43,000
	SUBTOTAL=				$3,214,740
19	Engineering/Design	15%			$325,900
20	Construction Management	10%			$321,500
21	Contingency	25%			$884,100
	TOTAL CAPITAL COSTS=				$4,745.240
22	Operations & Maintenance				$864,200
	TOTAL ALTERNATIVE=				$5,610,440
	NET PRESENT WORTH OF CAPITAL/O&M COSTS				$4,487,489

Summary of Present Worth Analysis Floodplain / Bank Soil - Removal of Soil With > 10 ppm					
Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (7%)	Present Worth
0			$0	1.000	$0
1			$0	0.935	$0
2	$4,746,240	$29,800	$4,776,040	0.873	$4,171,578
3		$29,800	$29,800	0.816	$24,326
4		$29,800	$29,800	0.763	$22,734
5		$29,800	$29,800	0.713	$21,247
6		$29,800	$29,800	0.666	$19,857
7		$29,800	$29,800	0.623	$18,558
8		$29,800	$29,800	0.582	$17,344
9		$29,800	$29,800	0.544	$16,209
10		$29,800	$29,800	0.508	$15,149
11		$29,800	$29,800	0.475	$14,158
12		$29,800	$29,800	0.444	$13,232
13		$29,800	$29,800	0.415	$12,366
14		$29,800	$29,800	0.388	$11,557
15		$29,800	$29,800	0.362	$10,801
16		$29,800	$29,800	0.339	$10,094
17		$29,800	$29,800	0.317	$9,434
18		$29,800	$29,800	0.296	$8,817
19		$29,800	$29,800	0.277	$8,240
20		$29,800	$29,800	0.258	$7,701
21		$29,800	$29,800	0.242	$7,197
22		$29,800	$29,800	0.226	$6,726
23		$29,800	$29,800	0.211	$6,286
24		$29,800	$29,800	0.197	$5,875
25		$29,800	$29,800	0.184	$5,491
26		$29,800	$29,800	0.172	$5,131
27		$29,800	$29,800	0.161	$4,796
28		$29,800	$29,800	0.150	$4,482
29		$29,800	$29,800	0.141	$4,189
30		$29,800	$29,800	0.131	$3,915
Totals	$4,746,240	$864,200	$5,610,440		**$4,487,489**

Appendix A - Responsiveness Summary

Sheboygan River & Harbor Site
Responsiveness Summary

General

G1. The Wisconsin Department of Natural Resources has developed Remedial Action Objectives for the Sheboygan River and Harbor Superfund Site. These objectives were forwarded to the EPA in our letters of March 19, 1997 and October 12, 1998 to Mr. Steve Padovani. These objectives are presented here again for your consideration in developing the Record of Decision.

1. Restore the surface waters of the Sheboygan River and Harbor to meet promulgated water quality standards (Wis. Admin. Code § NR 105,), developed to protect human health and the environment for identified contaminants of concern. The water quality-human cancer criterion for PCBs is 0.003 ng/L, and the wildlife criterion is 0.12 ng/L.

Response: There is currently a lot of debate about the use of deriving a sediment concentration target from a water quality standard. The U.S. EPA has currently not resolved this issue and has not accepted equilibrium partitioning as a generally accepted method for converting between sediments and water. WIthout an accepted method, or link, between sediments and water, Wis. Admin. Code § NR 105 is not an Applicable or Relevant and Appropriate Requirement (ARAR)at this site at this time.

2. Implement remedial actions to reduce PCBs in sediment, groundwater and floodplain soils to achieve water quality standards. The PCB sediment quality objective derived from the water quality standard is 0.001 - 0.014 mg/kg. The acceptable alternative objective of "background" concentration of PCB in sediment is 0.05 mg/kg.

Response: The primary goals of Superfund cleanups are to protect human health and the environment and to comply with ARARs. When ARARs are not available, Superfund develops a reasonable maximum exposure (RME) scenario that describes the current and future potential risk posed by the site in order to determine what is necessary to achieve protection against such risk to human health and the environment. A sediment quality objective derived from a water quality standard is not an ARAR.

While cleaning PCB-contaminated sediment to a background target of 0.05 ppm is a worthwhile goal, it is not required by the National Contingency Plan. The risk guidance requires that the RME scenario

be used for determining human health risks. In addition, Superfund's approach to ecological risk recommends a cleanup target between the No Observed Adverse Effects Level (NOAEL) and the Lowest Observed Adverse Effects Level (LOAEL). The background concentration of 0.05 ppm equates to the NOAEL for the mink, one of the three aquatic receptor groups analyzed in the NOAA risk assessment. However, as just mentioned current ecological risk recommendations don't mandate the selection of the NOAEL for addressing ecological risk.

The selection of a 0.5 ppm target for contaminated sediments is consistent with the NCP and current Superfund policy for human health and the environment.

3. Implement a remedy that allows the consumption of all indigenous fish and waterfowl species without unacceptable risk to human health. The remedy should achieve safe consumption levels in all fish and wildlife to allow consumption of six meals per year within 10 years and one meal per week within 30 years. These goals are based on the Wisconsin Division of Health guidelines for fish consumption.

Response: The selected remedy is expected to bring sediment and fish tissue levels within an acceptable risk range. CERCLA has defined an acceptable human health risk range of 1 in 10,000 to 1 in 1,000,000. The selected PCB sediment target goal is 0.5 ppm which equates to a human health risk of approximately 1 in 10,000, and within the acceptable risk range.

The current PCB sediment target of 0.5 ppm would allow for a fish consumption of 43 resident fish meals/year. This risk consumption approach is based on the reasonable maximum exposure (RME) scenario and would cover approximately 90 percent to 95 percent of the fishers in Sheboygan. The resident fish used in this scenario are small mouth bass and carp. By selecting a cleanup goal protective of bass (or carp), the cleanup will be even more protective of the lesser contaminated species such as salmon and steelhead and allow for more consumption of these other types of fish from the Sheboygan River.

4. Implement remedial actions consistent with the Sheboygan River Remedial Action Plan (RAP), Great Lakes Water Quality Initiative (GLI) and Water Guidance and Lakewide Management Plan (LAMP) to restore and protect the Lake Michigan ecosystems, including; 1) the reduction of toxicant transport to

Lake Michigan, 2) restoration of ecosystems damaged by the release of contaminants of concern.

Response: The selected remedy will reduce the remaining PCB mass in the upper reaches of the Sheboygan River. Because of the dynamic nature of upper river reaches, this PCB mass is considered the most mobile and vulnerable to resuspension. In addition, PCB-contaminated sediments near the surface of the Lower River and Inner Harbor, vulnerable to disturbance due to natural and human impacts are also being removed. By removing the PCB-contaminated sediments that are most likely to be disturbed, resuspended and migratory, the U.S. EPA expects to see a reduction in the transport of PCB-contaminated sediment into Lake Michigan through the selected remedy.

CERCLA gives the U.S. EPA the authority to react and remediate imminent and substantial endangerment to human health and the environment. The Natural Resource Trustees (Trustees) are given the authority to seek restoration of the resource through the pursuit of a damage claim under section 107(f) of CERCLA. The trustees (State of Wisconsin, U.S. Fish and Wildlife, and National Oceanic and Atmospheric Agency) may use their authorities under CERCLA to build upon the U.S. EPA selected remedy. The U.S. EPA strongly urges the trustees to exercise their authorities to obtain a more comprehensive site remedy that includes remediation and restoration. But again, restoration of the ecosystem is the jurisdiction of the trustees, not the U.S. EPA.

The Sheboygan River RAP, GLI and Water Guidance, and LAMP have been considered in selecting the site remedy. The RAP, GLI and LAMP are categorized as "To-Be-Considered", often referred to as "TBCs". These are guidances and policies that are not promulgated standards but are goals set by entities outside the Superfund Program. Obtainment of these goals is not mandatory, but is considered within the balance required by the NCP.

G2. The Wisconsin Department of Natural Resources needs the following documentation for review to satisfy its concerns about the Proposed Plan.

1. Documentation used to determine that an average river PCB sediment concentration of 1.0 ppm is protective of human health.

Response: The U.S. EPA has selected an average river PCB soft sediment concentration of 0.5 ppm based on the reasonable

maximum exposure (RME) scenario which assumes the consumption of 43 fish meals/year. The RME scenario will protect approximately 90 percent to 95 percent of the people eating resident fish from the Sheboygan River. An average PCB sediment concentration of 0.5 ppm and fish consumption of up to 43 fish meals/year will equate to an excess risk of approximately in 10,000. The NCP has established an acceptable excess risk range between 1 in 10,000 to 1 in 1,000,000. The current PCB sediment target of 0.5 ppm is within this risk range and consistent with the NCP.

2. How the EPA applied the nine criteria to the risk management decision process.

Response: A detailed explanation of the application of the nine criteria and the rationale for selection of the remedy is in Sections J and L of the ROD.

3. Justification for deviating from the recommendation of the Ecological Risk Assessment.

Response: The U.S. EPA has not deviated from the recommendation of the NOAA Aquatic Ecological Risk Assessment. Section 7.2 of Volume 1 of the risk assessment says that "protective sediment concentrations are intended to provide risk managers with information for selecting cleanup goals." For the purposes of making risk management decision about a site, ecological guidance recommends a cleanup target in between the No Observed Adverse Effects Level (NOAEL) and the Lowest Observed Adverse Effects Level (LOAEL). Total PCB protective sediment concentration ranges for the NOAEL and LOAEL for fish, heron and mink are provided in Table 6-11 of Volume 2 of the risk assessment. The protective range for fish is from 3.7 to 25 ppm. The protective range for heron is 0.14 to 0.97 ppm. The protective range for mink is 0.05 to 1.5 ppm. The selection of an average PCB sediment concentration of 0.5 ppm is within the NOAEL - LOAEL range for all three groups.

The last paragraph of the Volume 1 says:

> ***Therefore, based on the analysis presented in this risk assessment, cleanup goals similar to background sediment concentrations of PCBs in the Sheboygan River would be protective of ecological health (i.e., 0.05 ppm). This result corroborates the work previously conducted for the site (WDNR 1992b) and the conclusion previously stated by***

USEPA (1994) that recommended cleanup to background concentrations is appropriate for PCBs.

The U.S. EPA agrees that cleanup to background levels (i.e., 0.05 ppm) would be protective of ecological health. However, as previously noted levels between 10^{-6} and 10^{-4} for human health and between the NOAEL and LOAEL are also appropriate under the NCP using the nine criteria analysis.

4. Explanation of how final proposed sediment concentration values are protective of subsistence anglers uninfluenced by current fish consumption advisories.

Response: The ingestion rates used In the risk assessment were based on amount people fished and were uninfluenced by the current fish advisories. The selection of an average PCB sediment concentration of 0.5 ppm is not protective of <u>ALL</u> subsistence or high-end fishers. The RME approach will protect the vast majority of the total fishing population in the Sheboygan River. Based on consumption information obtained from the '93 West study, this level of cleanup will protect more than 50 percent of the subsistence fishers in Sheboygan. The RME approach to assessing site risk and using it as one element of the decision making process for the selection a remedy is consistent with the NCP.

Enhancing the remedy to include the protection of the most highly consumptive subsistence/high end fishers can be achieved by the State of Wisconsin and the other Federal Natural Resource Trustees under their authorities provided by CERCLA. The U.S. EPA urges the State of Wisconsin and the other trustees to use their authorities provided under CERCLA to enhance the remediation to include the highest consumptive fishers along with restoration of the ecosystem.

G3. Procedural Defects

a. Proposed Plan Defects. The goal of any proposed plan and supporting analysis is to provide the public with an understanding of what EPA is proposing and the basis for EPA's proposal, and to give the public a meaningful opportunity to comment on the proposal and its basis. In this instance, however, the Proposed Plan provides essentially no information on the details of what EPA is proposing, and provides no textual explanation whatsoever of the basis for the proposal. The Proposed Plan simply describes each alternative for each portion of the Site in one or two sentences, lists the nine NCP criteria for remedy selection, and provides a chart for each portion of the Site that lists the alternatives across the top, the nine criteria down the side and a box in the intersecting matrix cell. For a $66 million proposed remedy, this approach is fundamentally defective.

Response: The comment has no basis in law. The NCP provides instruction on the content of a proposed plan. The proposed plan is intended to describe the Agency's proposed action to the public in a "brief" and summary fashion. The Agency is not obligated to provide significant details in the proposed plan. The NCP, at 40 CFR Part 300.430(f)(ii)(E)(2), states that the proposed plan, at minimum, "shall":

(i) Provide a brief summary description of the remedial alternatives evaluated.....;
(ii) Identify and provide a discussion of the rationale that supports the preferred alternative;
(iii) Provide a summary of any formal comments received from the support agency;
(iv) Provide a summary explanation of an waivers identified......."

The proposed plan for the Sheboygan River and Harbor Site provides the brief and summary description of the alternatives, the rationale supporting the preferred alternative, formal comments, and any waivers sought. Therefore, the proposed plan is consistent with the NCP.

b. Administrative Record Support. EPA has failed to tell the public which document or documents in the administrative record it considered or relied upon in developing its proposal

Response: The comments have no basis in fact or law. The Administrative Record (AR) serves two distinct functions within the Superfund process. First, the AR provides the public with access to information regarding the site. Second, the AR acts as the official repository of information considered or relied on by the Agency in making the final remedy selection that is embodied in the Record of Decision (ROD). Section 113 (j) of CERCLA provides that an AR shall be established that, for remedial actions, provides procedures for each of the following:

(i) Notice to potentially affected persons and the public, which shall be accompanied by a brief analysis of the plan and alternative plans that were considered;
(ii) A reasonable opportunity to comment and provide information regarding the plan;
(iii) An opportunity for a public meeting in the affected area.....;

(iv) A response to each of the significant comments, criticisms, and now data submitted in written or oral presentations; and
(v) A statement of basis and purpose of the selected action.

The NCP provides regulations regarding the content of the AR. It is important to note that the AR is not complete until the ROD is signed. The body of documents that the Agency considered and relied on in selecting the response action can only be complete at the time the decision is made. The NCP provides a list of the types of documents that should be available in the AR. There is no requirement in the NCP that the Agency specifically detail which documents it relied on to present a preferred alternative. Tecumseh, as preparer of the RI/FS has access to significant information and expertise that the general public does not. In fact over and above the requirements of the NCP, Tecumseh requested and was granted a meeting with the Regional Division Director to discuss the basis of the proposed plan. Information from that meeting clearly appears in the Tecumseh comments.

c. The U.S. EPA failed to resubmit the Inner Harbor proposal to NRRB after fundamentally changing it.

Response: This statement is incorrect. The U.S. EPA did resubmit a revised Inner Harbor alternative to the National Remedy Review Board in July 1999.

G4. Neither the U.S. EPA or PRPs have provided estimates on how the proposed plan will affect loadings to the lake in the long-term.

Response: The U.S. EPA selected remedy will reduce long-term PCB loadings to Lake Michigan as the PCB contaminated sediments most vulnerable to disruption, resuspension and migration will be removed from the river.

G5. US EPA's plan must cleanup river and harbor sediments to at least 0.05 ppm to comply with Wisconsin's surface water quality standards.

Response: This comment has no basis in law. State Water Quality Standards (WQS) are not ARARs for sediment contamination. The NCP states that, in establishing Remedial Action Objectives (RAOs), Water quality criteria established under the Clean Water Act (WQSs in Wisconsin), shall be attained where "relevant and appropriate under the circumstances of the release." The Agency has determined that WQS's while relevant to sediment clean up RAOs, are not appropriate for direct

application at this time. Calculating a site specific sediment quality standard from a WQS using current scientific methods such as equilibrium partitioning is very uncertain. Moreover, the Agency's 1996 Superfund PCB clean up guidance directly addresses sediment clean up targets using water quality criteria. The guidance suggests using equilibrium partitioning to develop a sediment criteria and then compare it to risk based clean up numbers for establishing an RAO as would be done with a non-ARAR. If the guidance considered a derived sediment quality number to be an ARAR, it would be directly applied to each alternative as a threshold criteria. Therefore, WQSs are not ARARs and are not a threshold criteria for selecting an alternative at the Site.

G6. The cleanup plan must comply with the Great Lakes Water Quality Agreement.

Response: This comment has no basis in law. The Great Lakes Water Quality Agreement is a document signed by EPA and Environment Canada. As such it is not a promulgated law of the United States and is not legally enforceable. ARARs by definition must be promulgated laws or regulations that are legally enforceable and generally applicable. Therefore, the Great Lakes Water Quality Agreement is not a threshold criteria for selecting an alternative at the Site.

G7. The US EPA should ensure that contaminated sediment can be easily removed from the landfill once the agency identifies appropriate permanent remediation techniques.

Response: In time, permanent and cost effective remediation techniques may be available that allow remediation of PCB-contaminated in place. Any contaminated sediment taken off site and disposed of in an in-state or out of state approved landfill will be properly maintained to ensure protectiveness and prevention of release. At this time, disposal in and removal from a landfill is not proposed as part of the site remedy.

G8. The Sheboygan County Chamber of Commerce urges EPA to select the recommendation in the Feasibility Study as the final remedy for the Sheboygan River and Harbor.

Response: Comment Noted.

G9. The Sheboygan County Board of Supervisor's Resources Committee and Land Conservation Committee formally express their support for the U.S. EPA's preferred cleanup plan for the Sheboygan River & Harbor Superfund Site, subject to U.S. EPA assurances that Sheboygan County officials will be fully informed and active participants in the design, development and implementation of the final cleanup plan.

Response: Comment Noted. The Lake Michigan Federation (LMF) has received a Technical Assistance Grant (TAG) which gives them the responsibility of acting as technical advisor and conduit for community concerns. The best avenue for participating in the design and implementation process would be through the LMF TAG. The U.S. EPA urges the Sheboygan County Board of Supervisor's Resources Committee and Land Conservation Committee to utilize this local resource to express their concerns during the future phases of the project.

G10. The Sheboygan Area Great Lakes Sport Fisherman requests a 98 percent cleanup of all PCB hot spots for the "Whole River". Hot spots include any area over 10 ppm of PCB's.

Response: Under the Superfund program, the term "hots spots" does not have a specific definition or threshold for determining what level of contamination is considered "hot". The National Contingency Plan (NCP) defines the "principal threat" concept as "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, surface water, or air, or acts as a source for direct exposure. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur.

Although no "threshold level" of risk has been established to identify principal threat waste, a general rule of thumb is to consider as a principal threat those source materials with toxicity and mobility characteristics that combine to pose a potential risk several orders of magnitude greater than the risk level that is acceptable for the current for future site use. Based on human health and ecological risks, contaminated sediment with levels exceeding 50 ppm would be considered a principal threat waste. For the Site, PCB-contaminated sediment exceeding 50 ppm will be considered a principal threat waste when found in areas subject to human or natural disturbances.

In addition, the TSCA level for PCBs is defined by concentrations greater than 50 ppm. PCB concentrations greater than 50 ppm require disposal in an approved hazardous waste landfill. Therefore, for the purposes of establishing a hot spot threshold, 50 ppm is selected for the Sheboygan River and Harbor Site.

G11. The Sheboygan Area Great Lakes Sport Fisherman request that the Sheboygan River be cleaned up to the point that all fish and wildlife advisories could be lifted and that it be made suitable for all recreational uses.

> ***Response: The selected remedy is expected to bring sediment and fish tissue levels withing an acceptable risk range. The selected PCB sediment target goal is 0.5 ppm which equates to a human health risk of approximately 1 in 10,000, and within the acceptable risk range. The current PCB sediment target of 0.5 ppm would allow for a fish consumption of 43 resident fish meals/year. This risk consumption approach is based on the reasonable maximum exposure (RME) scenario and would cover approximately 90 percent to 95 percent of the fishers in Sheboygan. The resident fish used in this scenario are small mouth bass and carp. By selecting a cleanup goal protective of bass (or carp), the cleanup will be even more protective of the lesser contaminated species such as salmon and steelhead and allow for more consumption of these other types of fish from the Sheboygan River. The selected remedy is expected to reduce PCB levels in wildlife and may, in time, reduce the reliance on wildlife advisories.***

G12. The Sheboygan Area Great Lakes Sport Fisherman would like to the river monitored for a minimum of 20 years after the PCB cleanup has been completed.

> ***Response: The selected remedy calls for monitoring all river segments of the site, including the Inner Harbor, for 30 years after the remediation has been completed, or until fish consumption advisories are lifted. Long-term monitoring includes both sediment and fish sampling.***

G13. The Sheboygan County lzaak Walton League urges the U.S. EPA to issue a final plan for cleaning up the Sheboygan River and Harbor which is more protective of the community than envisioned in the “Proposed Plan for Cleanup of the Sheboygan River and Harbor Superfund Site” issued in May 1999.

> ***Response: The proposed plan called for a PCB sediment clean up target of 1.0 ppm. The selected remedy calls for a PCB sediment clean up target of 0.5 ppm. Tecumseh Products Company has continually expressed a desire to implement a remedy that addresses both Superfund requirements and natural resource trustee requirements. The natural resource trustees; WDNR, U.S. Fish and Wildlife, and NOAA are given responsibilities and authorities beyond the Superfund responsibilities and authorities. The selected remedy is based upon the nine criteria summarized in the ROD and is protective of human health and the environment.***

G14. Kohler Co. has publicized its intentions to restore the historic Riverbend Property within the next several years. It will be necessary to coordinate removal activities in the area surrounding this portion of the Kohler Co. property with the restoration project timetable. It is Kohler Co.'s expressed intention to cooperate with USEPA, WDNR and Tecumseh in granting access for the proposed removal activities.

> ***Response: The U.S. EPA appreciates Kohler's expression of cooperativeness and the U.S. EPA will work closely with Kohler Company to coordinate removal activities surrounding the restoration project.***

G15. The Sheboygan County Conservation Association would like to recommend that an ocean vacuum cleaner system be used. The sediment collected should be put in casts or stored in tanks, or hauled to a place where it could be burned. Heavy metals should also be screened out of the ensuing sludge.

> ***Response: Specifics concerning the excavation technology used, transportation, and disposal will be determined during the design phase of the project. The items suggested are noted and can be considered during the design of the remedy.***

G16. The Sheboygan County Conservation Association feels that it is critical that the clean-up is completed within 10 years of any decision. Complete to the point where warnings are no longer necessary on fish or wildlife.

> ***Response: Implementation of the remedy will occur in as quickly as possible. The comment derives "completion" as when fish and wildlife advisories are removed from all segments of the river and harbor. Given this definition, the 10 year timeframe requested is unlikely. Although it's anticipated that the implementation of the remedy will be completed within 10 years, it will take some period of time for fish and wildlife life cycles to repeat so that fish and wildlife exposed to excessive levels of contamination are no longer present in the eco-system. In addition, under the selected remedy not all PCB contaminated sediment will be removed from the river. A comprehensive long-term monitoring plan will track contaminant concentrations in wildlife over time. When appropriate, fish and wildlife advisories may be revised or removed.***

G17. EPA's $66 million dollar clean-up plan clearly does not meet the cost-effective standard when considering the scientific evidence.

> ***Response: It is unclear what "scientific evidence" the comment is referring to so a specific response to the scientific basis of the alternatives is not possible. However, Section 300.430 (f)(1)(ii)(D) of the NCP requires U.S. EPA to evaluate cost effectiveness by comparing all the alternatives that***

meet the threshold criteria (protection of human health and the environment and compliance with ARARs) against three balancing criteria (long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, and short-term effectiveness). The selected remedies meet these criteria by achieving a permanent protection of human health and the environment at low risk to the public, and provide for overall effectiveness in proportion to their cost.

The Superfund program does not mandate the selection of the most cost effective cleanup alternative. Finally, the most cost effective remedy is not necessarily the remedy that provides the best balance of tradeoffs with respect to the remedy selection criteria nor is it necessarily the least-costly alternative that is both protective of human health and the environment and ARAR-compliant.

G18. The completeness of the proposed soft sediment dredging may be limited by the future contributions from sediments in the hard material or gravel areas. Soft sediments make up about 15 percent of the river bottom; the remaining 85 percent is made up of hard material areas. Because sediments in the hard material areas will not be dredged, they will remain in the river and may be washed into the soft sediment areas, along with floodplain and other upstream sediments during high flow events. Limited sampling indicates that sediments in the hard material areas may range from 2 to 3 ppm. Therefore, once soft sediments are dredged to the overall cleanup goal of 1 ppm, hard sediments may re-contaminate this area in the future. The proposed cleanup plan does not acknowledge that such re-contamination may occur, how to mitigate it if it does occur, and how it will affect the overall cleanup goal.

Response: WDNR sampling of soft sediment in the hard sediment areas (generally representing 85 percent of the river bed) showed an average of approximately 2.5 ppm. Although the hard sediment areas represent the a majority of the river bed surface, soft sediment generally found either under or between rocks and cobbles, isn't anticipated to have a proportionately large PCB mass as compared to soft sediment deposits. Therefore, the U.S. EPA doesn't anticipate that the soft sediment in the hard sediment areas will have a significant impact on future recontamination or adversely effect the soft sediment SWAC target for the site. However, because contamination will be left in place, the NCP requires that the site undergo a periodic review to determine the effectiveness of the site remedy. This will occur every 5 years.

G19. Removal of sediment with a clamshell bucket will release some sediment into the water during the removal process. How will downstream migration of this sediment be prevented?

Response: Engineering controls like silt curtains have been effectively used in the past to mitigate release of contaminated sediments downstream. This continues to be a viable approach to dredging in the river, but other dredging approaches will be evaluated during the design phase to select the best approach for each river component.

G20. I was prompted to write to you after I got an update publication from Tecumseh (July 1999) that listed “Comments from the Community”, but it only listed those comments that supported their point of view! This gives the wrong impression to the rest of the community that did not write, as it appears that only anti-dredging/anti-clean up comments were sent to Tecumseh. I sent comments in May which did not support minimal or no dredging, but my comments were disregarded and I wonder if they were passed along to EPA.

Response: While I cannot find the comment card you have submitted to Tecumseh, the U.S. EPA received many comments both agreeing and disagreeing with Tecumseh’s preferred alternatives from Tecumseh between June and August of 1999.

G21. I would be satisfied with the 95 percent removal of 7,500 cubic yards of sediment instead of the 18,200 cubic yards the EPA recommends, simply on the basis of cost effectiveness.

Response: Cost effectiveness is just one of nine criteria the U.S. EPA must took at in selecting a Superfund remedy and cannot make a decision on cost effectiveness alone.

<u>Upper River</u>

U1. Proposed Remedy for the Upper River is inconsistent with the NCP.

a. The remedy recommended in the FS provides the same long-term effectiveness as the proposed remedy.

Response: The arguments presented for the FS preferred alternative having the same long-term effectiveness as the alternative presented in the U.S. EPA Proposed Plan focus on the following points.

1. Surface-weighted average concentration (SWAC) weighting for soft sediments deposits and hard sediment areas.

2. PCB Half-Life Analysis.

The FS preferred alternative assumes a 15 percent weighting for soft sediment deposits and 85 percent for hard sediment areas based on the 2 dimensional surface area approach to the river. However, 15 percent likely under represents the risk impact of PCBs in the soft sediment deposits. There are a number of reasons for this.

1. *The proposed 15 percent / 85 percent weighting approach assumes a static model and is not representative of a dynamic river system. The soft sediment PCBs, in the Upper River, are more likely to be mobilized and transported in comparison with hard sediment PCBs. This difference in mobility is not accounted for by the 15 percent/ 85 percent surface area weighting. During sediment investigations, conducted as part of the NOAA Aquatic Risk Assessment in July and August of 1997, NOAA and WDNR staff observed that soft sediment deposits had shifted or had been significantly disturbed in portions of the Upper River demonstrating the vulnerability and mobility of these soft sediments.*

2. *The proposed 15 percent / 85 percent weighting approach does not address source control, that is, PCB-contaminated soft sediment deposits are the most likely source of PCBs to other parts of the river. An analogy would be a large pile of contaminated dirt from which a plume of dirt has blown off downwind. The plume of blown-off dirt would appear to be the major repository of contaminants based solely on an aerial comparison of the two-dimensional surface area of the pile versus the area of the plume. Emphasizing remedial efforts on the plume as a result of this two dimensional comparison would be a mistake. In contrast, consideration of mass and potential mobility would correctly focus the cleanup efforts on the pile, and secondarily on the dispersed plume, if cleanup of the disbursed plume was even feasible.*

3. *The proposed 15 percent / 85 percent weighting approach does not take into account the likely differences in spatial dispersion between hard and soft sediment PCB accumulations. PCBs are unlikely to occur in truly hard bottoms. They are more likely presented in scattered inclusions of fine sediments between the rocks and cobbles. If so, it is inappropriate to compare the total area in which scattered deposits of PCBs occur in hard sediments against the surface area of soft sediment deposits. In other words, the hard sediment area doesn't accurately reflect the proportion of*

the hard sediment area that consists of fine sediment inclusions. It is more likely that the average PCB concentration for the hard sediments is lower than the 2.5 ppm estimated and would show that removing soft sediment deposits resulting in an average SWAC of 0.5 ppm would result in a much lower overall Upper River SWAC than currently estimated in the FS. However, even this adjustment for the spatial dispersion of soft sediments in the hard sediment area would not address the source concern discussed previously.

4. ***The proposed 15 percent / 85 percent weighting approach does not accurately account for the ecological risks for many of the fish species that reside in the Sheboygan River. Information submitted by Blasland, Bouck & Lee, Inc. (BBL), administrative record update #3, Item # 41, indicates that smallmouth bass prefer the hard sediment areas which they contend supports the FS's 15 percent / 85 percent SWAC weighting. However, state-wide surveys of fish species reported to forage in the Sheboygan River show that even smallmouth bass often frequent sand/silt/mud areas greater than the 15 percent assigned to the soft sediment deposits. Moreover, the benthic community that forms the base of the food chain lives predominantly in the soft sediment deposits and the slower water associated with those areas of the river. The frequency of soft bottom types associated with various fish species in the Sheboygan River can be found in the ROD.***

5. ***The proposed 15 percent / 85 percent weighting approach underestimates risks to other wildlife. This is especially true for piscivorus wildlife such as the mink and blue heron. The food chains for both species are linked to soft sediments. It is the PCBs associated with soft sediments, not a weighted average concentration, which are available to these species. The blue heron is an opportunistic feeder that utilizes sight to locate prey. It does this by wading or standing and waiting for prey. Such feeding behavior requires still or slow moving water so that prey may be observed and captured. This type of feeding strategy cannot be efficiently implemented in the riffle areas, which are associated with hard sediments. Unlike the blue heron, mink are capable of consuming large prey such as carp, which will also be more closely associated with soft sediments.***

Based on all of this information, soft sediment deposits likely play a much larger role in risks to the river system than the 15 percent attributed to them in the Feasibility Study and will vary depending on the receptor analyzed. An analysis of SWAC sensitivity can be found in the ROD and shows that the greater impact soft sediment deposits in the overall river SWAC calculation, the more significant removal of the soft sediment deposits become. Not only by sheer mathematics it is correct, but the qualitative information presented earlier indicates that the soft sediment deposits likely have a greater impact than the 15 percent proportion the FS assigns.

In summary, the remedial objective of the Upper River is to remove approximately 88 percent, or more, of the remaining mass in the soft sediment deposits. This is expected to achieve a soft sediment deposit SWAC of 0.5 ppm, or less, and is likely to result in an overall Upper River SWAC of 0.5, or less, shortly after remediation because the average PCB concentration for the hard sediments is likely overstated as it doesn't account for the actual spatial distribution of soft sediment in the hard sediment area.

These points are not "twists" of SWAC analysis as Tecumseh asserts, but critical to the evaluation of the long-term effectiveness of the selected remedy.

The PCB half-life analysis presented by Tecumseh, or the estimated time for PCB concentrations to decline by 50 percent, was estimated to be 8 years on average, but ranged from 1 year to 23 years. The 8 year average is based on a small set of locations in the Upper River. The small data set and variability of the data make the analysis highly questionable for accurately projecting PCB concentrations for the entire river over time.

Lastly, neither the SWAC or PCB half-life analyses presented in the comment adequately account for source material getting back into the river system once remediation is complete. Under the FS preferred alternative, only 62 percent of the remaining Upper River PCB mass is removed. Under the selected remedy, 88 percent of the remaining PCB mass is removed. While obvious, it is important to reiterate, that the more source material removed from the river, the greater the long-term effectiveness of the remedy.

Based on all of the above, the U.S. EPA disagrees that both the FS preferred alternative and EPA selected recommended alternative have the "same long-term protectiveness."

b. The remedy recommended in the FS provides greater short-term effectiveness than the proposed plan remedy.

> ***Response: While the U.S. EPA proposed alternative for the Upper River will take longer and the chance of failure of a silk curtain is greater, the U.S. EPA does not anticipate that dredging of soft sediment in the Upper River will be any less successful than the removal action implemented by Tecumseh in the past. In addition, the comment characterizes the Proposed Plan alternative as only removing a few more percent of PCB mass on a cumulative basis. While this is factually true it clouds what it actually proposed. Current levels of PCBs in fish are not a reflection of PCB mass in the river over 9 years ago. They are a reflection of remaining PCBs in the river. The Tecumseh preferred alternative includes removing approximately 62 percent of the remaining PCB mass in the Upper River. The selected remedy for the Upper River removes approximately 88 percent of the remaining PCB mass in the Upper River.***

c. The amount of PCB removal assumed for the proposed remedy cannot be obtained at the estimated cost.

p. 25. "Although a better than 98 percent average mass removal efficiency was achieved during the initial removal action, this resulted from a focus on the highest concentrations of PCBs, where the most mass was present. In addition, future dredging in the Upper River is unlikely to achieve a 90 percent reduction in SWAC, because the pre-dredging concentrations in the remaining deposits are much closer to the post-dredging concentration goal."

> ***Response: During implementation, dredging efficiencies will vary from deposit to deposit and it's difficult to predict what the overall efficiency will be. In addition, lessons learned from previous removal activities at the site should assist in keeping dredging efficiencies higher. To be conservative, for estimating purposes, the U.S. EPA has revised the assumed dredging efficiency from 98 percent to 90 percent.***

d. The incremental costs of removing more PCBs than the remedy recommended in the FS are huge and unjustifiable.

p. 26. Tecumseh's comments on the EPA's conceptual proposal to the NRRB showed that the Proposed Plan would remove a negligible additional amount of PCB mass on a cumulative basis relative to the FS-recommended alternative, at about double the cost. Moreover, the cost of the Proposed Plan per kilogram of PCB mass removed would be approximately 40 percent higher that the cost of the FS-recommended alternative per kilogram of PCB mass removed, even though only an additional 4 percent of the PCB mass would be removed on a cumulative basis.

Response: Tecumseh analyzed the Upper River removal alternatives in terms of the "cumulative" amount removed which, as noted above, is incorrect. A better basis for analysis is to compare the percentage of mass removal based on the amount that <u>currently</u> remains.

Here is how the various Upper River removal alternatives compare, assuming a 90 percent dredging efficiency.

Alternative Number	***PCB Mass Removed***	***Alternative Number***	***PCB Mass Removed***
3-I	***34%***	***3-IV***	***78%***
3-II	***62%***	***3-IV-A***	***88%***
3-III	***72%***	***3-V***	***90%***

The FS-recommended Upper Alternative 3-II removes 175.1 kg, or 62 percent while the EPA selected alternative removes 249.5 kg or 88 percent of the remaining mass. Alternative 3-IV-A removes an additional 74.4 kilograms of PCBs, or 42 percent more than alternative 3-II.

Comparing the alternatives for the remaining PCB mass in the Upper River, the U.S. EPA's selected remedy removes 40 percent more PCB mass than the FS-Recommended Alternative. Focusing on the remaining PCB mass shows that the mass removal and costs aren't so disproportionate as asserted by Tecumseh.

The Superfund program does not mandate the selection of the most cost effective cleanup alternative. The most cost effective remedy is not necessarily the remedy that provides the best balance of tradeoffs with respect to the remedy selection criteria nor is it necessarily the least-costly alternative that is both protective of human health and the environment and ARAR-compliant. Selection

of an alternative that removes less than the selected alternative would not meet the risk threshold criteria.

e. External source investigation results indicate that the remedial action for bank soils and preferential pathways will be more cost-effective than an overemphasis on sediment removal.

p. 27. If an external source is affecting the Upper River, a remedy emphasizing the removal of submerged sediments may not produce the intended remedial benefits. More importantly, other source control measures that are more cost-effective than additional incremental sediment remediation may produce those same results. ... These preliminary results provide strong evidence that PCBs entering the river from bank soils or associated preferred pathways from the Tecumseh plant are a substantial cause of the PCB levels currently observed in the Upper River fish.

Response: Tecumseh has asserted that the introduction of "unweathered", or more chlorinated, PCBs from an external source is a much more significant factor with regards to PCB levels in fish tissue than from submerged contaminated sediments. However, while Tecumseh has conducted extensive investigations of the bank soils and sediments near the facility, which reveal that there may be a new or continuing source from the facility, it's less clear what the relative impact of the continuing source is versus existing contaminated sediment since it is not known when this external source actually began introducing PCBs to the river. It's assumed from the interim monitoring program data that the elevated mean total PCB concentrations in white suckers and smallmouth bass, in 1998, in the vicinity of Rochester Park are a result of this now source.

Unfortunately, there is no bank soil or sediment data that would accurately bracket the existence of this now source. In addition, it's not known whether elevated bank soft and river sediment samples are a result of a one time event or a new continuing source. However, Tecumseh uses this possible new source as rationale for not removing more contaminated sediment than proposed in Upper River alternative 3-II. While this spike in fish tissue levels may be due to this new source, previous fish tissue samples were at levels above the proposed targets. So that the FS recommended alternative would only result in a return to previous unacceptable levels once the source is removed or controlled

f. EPA Failed to address the recommendations of the NRRB.

p. 28. "...the NRRB recommended that EPA "fully consider" Tecumseh's analysis and supporting assumptions before identifying a preferred alternative. Moreover, according to EPA, the NRRB stated that "there remain questions about how the costs, residual risks, and cleanup time frames compare among the alternatives," and recommended that EPA "more thoroughly evaluate how these factors change among alternatives to help identify appropriate mass removal and/or SWAC targets.

> ***Response: Since the U.S. EPA only received the Tecumseh analysis days before the NRRB meeting, we hadn't been able to analyze the new information. As a general course of action the NRRB requested that EPA thoroughly evaluate the new information before issuing a Proposed Plan for the site. The U.S. EPA did thoroughly review and analyze the information provided by Tecumseh and had significant concerns with it. The review and analysis is detailed in the response letter to the NRRB dated May 21, 1999 and is part of the Administrative Record. Many of these same issues have been repeatedly submitted during the public comment period and responses are presented in this Responsiveness Summary.***

"...EPA has failed to provide any substantive, supportable analysis in responses to the NRRB recommendations. EPA ultimately responds to the NRRB comments by relying on arbitrary adjustment of the ratio among soft sediments and non-soft sediments, on vague and unsubstantiated statements about risks to human health and the ecosystem, and on the general statement that the more mass removed from the system, the more likely the target SWAC goals will be achieved in the shortest period of time."

> ***Response. These issues have been addressed in a previous comment and the U.S. EPA determinations are not arbitrary, vague or unsubstantiated.***

"...EPA policy clearly states that cancer risk estimates should be expressed as only one significant figure, making the estimated risk of 1×10^{-4} for Alternative 3-IV and 7×10^{-5} for the Proposed Plan both within EPA's target risk range and virtually indistinguishable from one another."

> ***Response. While the characterization of risk differences may be small, they are not "indistinguishable". The NCP characterizes acceptable exposure levels as generally between 10^{-4}, and 10^{-6}. However, the 10^{-6} risk level shall be used as the point of departure for determining remediation goals. The selection of alternative***

3-IV-A equates to a soft sediment human health risk level of 10^{-4} which is not inconsistent with the NCP.

U2. Although several details of USEPA's Proposed Plan will be outlined in the design phase, careful consideration should be given to the sequence of the proposed removal actions. It is appropriate that the project proceed from the uppermost portion of the river, the source, and move down river. In this manner down river migration of PCBs released as a result of the removal actions, although presumed minimal, may be mitigated.

Response: To increase the effectiveness of the entire river remedy, it would be advantageous to implement the Upper River and Floodplain soft remedies first, but some overlap of the Middle River, Lower River, and Inner Harbor remedies may be achieved to reduce the overall length of time of the site remedy without adverse impacts.

U3. Once soft sediments are dredged to the overall cleanup goal of 1 ppm, hard sediments may re-contaminate this area in the future. The proposed cleanup plan does not acknowledge that such re-contamination may occur, how to mitigate it if it does occur, and how it, will affect the overall cleanup goal.

Response: The Upper River and Middle River portions of the site are made up of soft sediment deposits and non-soft sediment areas (referred to as hard sediments in the question). The non-soft sediment areas are made up of rocks, cobbles, bare bedrock and an intermittent layer of soft sediment in between the rocks and cobbles. The PCB contamination in the hard sediment area is due to the scattered soft sediment. The remedy in the Upper River and Middle River portions of the site focuses solely on the soft sediment deposits, because removal of the soft sediment deposits is feasible.

Because of the dynamic nature of the river, soft sediment will continually migrate between soft sediment deposits and hard sediment areas. There is no way to stop the migration of soft sediments in the river. Once the final soft sediment deposit removal remedy is implemented, soft sediments in the hard sediment area will likely migrate to one of the many soft sediment deposit areas along with cleaner soft sediment coming In from upstream of the Tecumseh facility. The overall goal of the sediment remedy is to reach 0.5 ppm over the entire river system over time. Long-term monitoring of the entire river will disclose how sediment concentrations are changing over time and every 5 years the implemented remedy will be evaluated to ascertain whether the objectives are being met. If at any time, it is determined that sediment concentrations are not trending towards 0.5 ppm overall, then additional sediment removal would be implemented.

U4. The proposed plan does not address average concentration differences (pre-1990 was 9.3 ppm while 1997 was around 3 ppm) in Area 31 of the Upper River or indicate whether current data will be used when designing and implementing the overall dredging plan.

> ***Response: Because of the dynamic nature of the river system, soft sediment will continually migrate and along with that, PCB contamination. Prior to implementation of any sediment removal activity, characterization of the PCB contaminated soft sediments will be necessary to determine the most efficient manner to reach the site objectives. It is also advantageous to have the characterization effort occur as close to the removal activities as possible.***

U5. Access Area #8, located on the historic Riverbend property, as specified in the final Feasibility Study Report (April 1998) is not acceptable to Kohler Co. Kohler Co. will work with USEPA, WDNR and Tecumseh to locate an alternate access area.

> ***Response: The comment is noted. U.S. EPA recognizes the historic importance of the property and will work with all partes to locate an alternative access area to remove PCB-contaminated soft sediment deposits in that area of the river.***

U6. USEPA specifies removal of 26 highly contaminated sediment areas within the Upper River as its recommended alternative, however, the areas are not specifically identified. Areas with low-level PCB mass (e.g. Areas 25, 28A, 33, 36 and portions of Area 31) should be avoided; the gains would be outweighed by the negative effects of the removal activities which include habitat destruction and negative visual impacts.

> ***Response: The U.S. EPA notes Kohler's concerns. Removal of soft sediments in areas of high quality habitat will try to be minimized so long as it doesn't jeopardize the overall site remedy sediment objectives. Complete avoidance of removal activities due to negative visual impacts is not considered justifiable, but to minimize the perceived negative visual impacts, excavation schedules can be altered and destruction of high quality habitat will be reconsidered prior to remedy implementation.***

<u>Middle River</u>

M1. The proposed monitoring remedy for the Middle River is poorly defined and unnecessary.

> ***Response: The monitoring program would include sediment and biota sampling and will be specifically defined during the design phase of the***

site. A long-term monitoring program for the Middle River, like the other river components, is necessary to closely track sediment and fish concentrations over time. The Middle River comprises approximately half of the river miles from the Tecumseh plant to Lake Michigan and contains approximately 35,000 cubic yards of soft sediment. Although more widely disbursed than the Upper River, soft sediment In the Middle River is considered source material for both the Lower River and Inner Harbor A long-term monitoring program that doesn't include the Middle River would be incomplete.

Lower River & Inner Harbor

L1. The proposed remedy for the Lower River and Harbor is inconsistent with the NCP.

a. The NRRB Should Evaluate the proposed dredging remedy, particularly given its criticism of EPA's prior proposal for the Inner Harbor.

Response: The Proposed Plan alternative for the Inner Harbor was submitted to the NRRB on July 28, 1999. The NRRB is an advisory body not required by the NCP. However, the region believed that given the changes in the proposed remedy for the Inner Harbor, the NRRB should be provided an additional opportunity to review the proposal before a selection was made. The NRRB does not require sending copies of the NRRB package to the PRPs. This was done as a courtesy in March 1999, because of the cost of the entire remedy. The July 1999 meeting focused solely on the Inner Harbor and was based on information available in the Administrative Record. Tecumseh like everyone else was given an opportunity to submit comments on the proposed Inner Harbor remedy during the public comment period, which they have done. The Region 5 response to NRRB comments will be included in the Administrative Record.

b. The Monitored Natural Recovery Remedy Recommended for the Lower River and Harbor in the FS Meets the Remedy Selection Criteria of the NCP.

I. The Inner Harbor is depositional and the significantly affected sediments are deeply buried.

“In its submission to the NRRB, EPA agreed with the well-documented FS conclusions that Sheboygan Harbor is depositional and that the most heavily contaminated sediments are buried beneath several feet of cleaner sediments that do not merit any active remediation.

***Response:* At the time of the NRRB meeting in March 1999, the availability of detailed Inner Harbor bathymetric surveys was not known. Upon the availability of this information a bathymetric analysis was conducted to determine if the "well-documented FS conclusion" that the Inner Harbor is depositional was correct. An examination of the bathymetric data does show that on balance, the Inner Harbor is still depositional in nature. However, a closer examination of the bathymetry information shows that the vast majority of the deposition is occurring between the 8^{th} Street Bridge and the Inner Harbor mouth. Since 1991, the area between the Pennsylvania and 8^{th} Street Bridges has been a mix of deposition and scour.**

The previous assumptions made in the U.S. EPA Proposed Plan and the PRP-produced FS didn't account for the differences in deposition trends upstream and downstream of the 8^{th} Street Bridge. In light of the more detailed bathymetric information and in addition to other information, the U.S. EPA has selected an Inner Harbor remedy that addresses those sediments most vulnerable to disturbance due to human and natural impacts.

“EPA's submission to the NRRB also specifically agreed that whether natural recovery, capping, complete excavation, or a sediment trap is selected, 'long-term surficial sediments will be the same.' In other words, the long-term effectiveness of all the alternatives is identical.”

Response: Based upon a review of the detailed bathymetry for the Inner Harbor, the U.S. EPA revises its earlier conclusion that natural recovery, capping, complete excavation, and a sediment trap all have the same long-term effectiveness. Deposition trends vary widely between the Pennsylvania Avenue Bridge and Inner Harbor mouth.

“Absent any reasonable likelihood that a significant quantity of buried PCBs will be exposed, resuspended, and spread into the environment through human activities in the foreseeable future, a natural recovery remedy will be wholly protective of human health and the environment and will be effective over both the long-term and short-term.”

Response: The comment infers that surface sediments are not contaminated with PCBs or are not of a significant quantity to be concerned about. Sampling conducted by Tecumseh in

1999 show PCB concentrations ranging from 0.38 to 5.3 ppm. In 1987 PCB surface concentrations ranged from 0.17 to 5.8 pm. Even based on the limited sampling conducted in 1999, it shows that the overall surface concentration range has not changed much since 1987. In addition, the 5.3 pm sample located In an area between the Pennsylvania Avenue and 8th street Bridges has been shown to undergo significant scour.

An analysis of the Inner Harbor bathymetrys obtained by the USACE clearly shows that not only is there a likelihood of exposure, resuspension and spreading of PCBs at the surface, but that it has actually occurred and will continue to occur between the Pennsylvania Avenue and 8th Street Bridges. Since it doesn't appear that the area between these two bridges will undergo additional significant deposition, the natural recovery alternative is not wholly protective over the short- or long-term between these two bridges.

Lastly, Tecumseh submitted a propwash analysis during the public comment period it showed that up to the top foot of sediment would be disturbed by propwash effects. One of the underlying assumptions In the analysis was a minimum water depth of 5 feet Portions of the Inner Harbor between the Pennsylvania Avenue and 8th Street Bridges have equal to or less than 5 feet of water depth based on the 1999 bathymetry, Current water levels have been at or below the Low Water Datum and could remain there throughout calendar year 2000.

Information from the City of Sheboygan showed that most of the motor and sail boats would be allowed to move through the Inner Harbor with 7 feet of water depth. A review of the 1999 bathymetry shows that except for a narrow channel, most of the area between the Pennsylvania Avenue and 8th Street Bridges has 7 feet or less of water depth. This means that the top foot for almost the entire Inner Harbor between the Pennsylvania Avenue and 8fh Street Bridges could be disturbed by human activities.

ii. Surficial concentrations are presently near the remedial goal.

“The Proposed Plan establishes a remedial goal of an average river sediment PCB concentration of 1.0 ppm within 30 years. The current SWAC of the Inner Harbor is 1.6 ppm PCBs in the top 3 - 4 inches, determined using a methodology described in Exhibit 8 to these comments. Similarly, the depth-weighted average concentration of the top two feet of sediment is only 1.3 ppm."

> ***Response: The 1999 sampling event only obtained 14 surface samples for the entire Inner Harbor. These 14 samples are used to approximate the weighted concentration over almost 1,500,000 square feet. The representative surface area for the samples ranged from 37,000 to 166,000 square feet. This limited data set and variance in representative surface area is inadequate to accurately estimate the average PCB surface concentration.***
>
> ***A geostatistical approach was used to determine at what distances between sample points the data are no longer statistically correlating. In other words, to accurately estimate an average PCB concentration, the sampling scheme would want to take samples at a distance less than the range where points no longer correlate. This approach yielded a sample point distance of a little less than 30 meters. To adequately estimate PCB concentrations in the Inner Harbor, 170 samples would be necessary. The 14 obtained Is insufficient to base SWAC calculations for trend analysis in the Inner Harbor.***
>
> ***Lastly, the comment lacks any discussion on how deposition or scour is likely to occur in different parts of the Inner Harbor and how that may effect PCB concentrations over the long-term. U.S. EPA believes that portions of the Inner Harbor subject to sour will continue to act as a PCB source to the Inner Harbor and will keep the SWAC at or near current levels indefinitely.***

iii. Significant flood events have not caused surficial concentrations to increase.

> A. PCB concentrations in surface samples
>
> "The surface samples obtained from the Inner Harbor in May 1999 do not show elevated PCB concentrations. These results demonstrate that neither exposure of deeper sediment through scour nor deposition of sediments with higher PCB concentrations transported from upstream has occurred. Thirteen of the 14 samples exhibited PCB concentrations ranging from 0.38 ppm to 1.9 ppm, while the fourteenth sample concentration was 5.3 ppm. The arithmetic average concentration of the surficial sediments at

the 14 locations was 1.5 ppm. This concentration is approximately half of the average surface concentration observed during the RI sampling in 1987."

> ***Response: As noted in a previous comment, 14 sample locations is wholly inadequate to accurately estimate the average PCB concentration for the Inner Harbor over time. In addition, only 4 of the May 1999, sampling locations are near sampling locations taken in 1987, and one of the samples obtained in 1999, SD-4, is between two 1987 sample locations (H15 and H16). Therefore, only 3 of the 14 samples are close to or at the same sampling location as samples taken in 1987, making any determination of trends for the entire Inner Harbor suspect.***
>
> ***The three samples taken in 1999, that are near the 1987, sample locations are well beyond the 8th Street Bridge where you'd expect to see more sediment deposition and reductions in surficial PCB concentrations based on the bathymetry analysis. Of the 6 surface samples taken in 1999, between the Pennsylvania Avenue and 8th Street Bridges, no surface samples were at or below the target goal of 0.5 ppm.***

B. PCB data from sediment cores.

"Evaluation of sediment cores taken in the Inner Harbor in May 1999, also indicates that the August 1998 flood event (35-year event) did not result in increased PCB concentrations in the surface layer and that sediments at depth with elevated concentrations of PCBs remain at depth."

> ***Response: Three of the 4 sediment cores were taken well beyond the 8th Street Bridge where deeper water and additional deposition is not likely to result in increased PCB concentrations in the surface layer. U.S. EPA agrees with the general comment with regards to sediments beyond the 8th Street Bridge.***
>
> ***A problem with the sediment core data is that a date gap exists between 2 foot point and the 5 foot point, making the statement that "In each core, the highest PCB concentration for the intervals analyzed was in the 60 -***

72 inch segment," incomplete. While the statement is true, PCBs were apparently not analyzed in a 3 foot zone in the middle of the sediment core. This also makes the assertion that the PCB concentrations at 60 - 72 inch depth in 1999, are equivalent to the 36 - 48 inch depth in 1987, questionable and perhaps coincidental. The sediment core data obtained in May 1999, is not sufficient to adequately say that "sediments at depth with elevated concentrations of PCBs remain at depth" for the entire Inner Harbor.

C. Particle size analysis

Sediment Cores 1 (located near the Inner Harbor mouth) and 4 (just upstream of the 8th Street Bridge) each have coarser sediments at the surface than found in the 12- to 24-inch layer. Sediment Cores 2 and 3 (both between the 8th Street Bridge and Inner Harbor mouth didn't show particle size differences at the surface and 12- to 24-inch layer. This is consistent with the HEC-6 sediment transport model for these locations. These observations indicate that even during the August 1998 high flow (35-year event) the areas near cores 2 and 3 remained depositional.

Response: The U.S. EPA agrees with the general assertion that areas near cores 2 and 3 remained depositional during the high flow event in August 1998. A review of bathymetry differences between 1998 and 1999 doesn't show significant scour due to the high flow event. Any assessments with respect to the impacts of the August 1998 high flow event need to consider that neither the bathymetric analysis or the 1999 sediment cores would show the maximum effects of the high flow event because of the time lag between the actual event and when the sampling or bathymetry was done.

iv. The Proposed Plan purports to distinguish among the protectiveness and effectiveness of the alternatives without any basis.

"In Figure 5 of the Proposed Plan, EPA asserts that the monitored natural recovery alternative recommended in the FS does not meet the NCP criteria of overall protectiveness of human health and the environment or long-term effectiveness and permanence. EPA further asserts that the

Proposed Plan fully meets these criteria. No basis is provided for these purported distinctions among the alternatives.

> ***Response: The NCP does not require a detailed analysis of the alternatives in the proposed plan.***
>
> ***The U.S. EPA, in conjunction with the WDNR, and federal and state trustees prepared a proposed plan that briefly describes the remedial alternatives analyzed by the U.S. EPA, proposes a preferred remedial action alternative and summarizes the information relied upon to select the preferred alternative. This was done in the form of a fact sheet, consistent with the NCP and other Superfund sites in Region 5. Figure 5, or small variations thereof, is the form the comparative analysis takes in Region 5.***
>
> ***The proposed plan is just one of many documents the U.S. EPA establishes as part of the an Administrative Record that contains all documents that form the basis for the selection of a response action. As mentioned in a previous comment, the Administrative Record is not complete until the Record of Decision Is signed.***
>
> ***In addition, under specific circumstances, the U.S. EPA may add documents to the administrative record after the decision document has been signed.***

"Given the low surficial concentrations present in the Lower River and Harbor, the absence of unacceptable risk from the current fish tissue concentrations in the Lower River and Inner Harbor, the depth at which the elevated concentrations of PCBs are buried, and the very low likelihood that any natural or human force is going to disturb those concentrations, EPA's distinctions appear wholly unjustified. Even if there were some remote possibility that deeper sediments could be re-exposed in isolated locations, EPA provides no information or analysis showing that such an event would result in an unacceptable risk to human health or the environment."

> ***Response: The NCP only requires that an imminent and substantial risk exist to take action. However, U.S. EPA has determined that the selection of a PCB concentration of 0.5 ppm satisfies the NCP's nine criteria. Previous responses have already discussed the bathymetric analysis and the very low likelihood that significant deposition is going to occur***

between the Pennsylvania Avenue and 8th Street Bridges. In addition, some areas of the Inner Harbor have and may in the future undergo significant scour, exposing higher levels of PCB contamination.

Tecumseh's own propwash analysis shows that the top foot of sediments can be disturbed. Over 80 percent of the boats using the Lower River and Inner Harbor need 5 feet of water depth with the remaining boats needing 7 feet of water depth or more. Based on the 1999 bathymetry, large portions of the area between the Pennsylvania Avenue and 8th Street Bridges have 7 feet of water or less. This means that much of the surface sediment between these bridges is vulnerable to disturbance.

Even based on the limited data set current PCB concentrations at the surface remain above the target goal of 0.5 ppm. Considering that an analysis of the harbor bathymetry shows little additional deposition is likely to occur between these bridges, nearly half the area of the Inner Harbor is likely to remain above the target goal. The assertion that re-exposure of deeper sediments is remote is more accurate for sediments between the 8th Street Bridge and the Inner Harbor mouth.

"Finally, EPA asserts that the Proposed Plan partially meets the criterion of reduction of contamination toxicity, mobility, or volume through treatment, even though the Proposed Plan does not include any more treatment than the FS-recommended alternative. Once these arbitrary and unfounded distinctions are removed, the monitored natural recovery alternative clearly becomes preferable under the NCP, as it cost-effectively protects human health and the environment over both the short- and long-term."

Response: The U.S. EPA agrees that none of the Lower River and Inner Harbor alternatives reduce toxicity, mobility, or volume through <u>treatment.</u> The Figure 5 is in error. In fact, Figures 3 and 6 should also show "blank boxes" for each alternative under this criteria. The U.S. EPA appreciates the commentor noting the error.

This being the case, Reduction of Contaminant Toxicity, Mobility, or Volume Through Treatment is not a factor, in the decision making process for all the alternatives for the Upper

River, Lower River and Inner Harbor and Floodplain Soil components of the site. All equally do not meet this criteria. The U. S. EPA disagrees that monitored natural recovery is clearly the preferred alternative under the NCP.

C. EPA justifications for the proposed dredging have no basis in fact.

1. Justifying an extremely costly remedy through “propeller wash” is unprecedented and would require full technical substantiation.

“Using the risk of propeller wash (prop wash) from recreational watercraft as a basis for justifying a costly environmental dredging project is unprecedented in the Superfund remedial action program.”

Response: The effects of prop wash to justify the selection of a remedy that includes dredging is just one element of the remedy rationale. Other elements of the rationale for the Inner Harbor remedy Include the bathyrnetry analysis and an analysis of PCB concentrations at depth in the Inner Harbor. The 1999 “ROD of the Year” issued on September 30, 1999, for the Pacific Sound Resources Site in Seattle, Washington, did use navigational concerns as part of the remedy selection rationale. However, even if something is unprecedented, that doesn't make it Inconsistent with the NCP.

“Tecumseh has been unable to locate any ROD that selected or rejected a natural recovery remedy because of the specter of prop wash from recreational boating.”

Response: The 1999 “ROD of the Year” issued on September 30, 1999, for the Pacific Sound Resources Site in Seattle, Washington, did use navigational concerns as part of the remedy selection rationale. The Sheboygan River and Harbor site may be the first site where analysis of prop wash effects were quantified and explicitly factored into the decision.

“Moreover, as discussed further below, the current record provides no evidence that recreational watercraft are in fact significantly resuspending any buried PCBs in the Inner Harbor, and there is no technically sound reason to believe that they could do so. Under these circumstances, proceeding with a dredging remedy based on mere speculations would be highly imprudent.”

Response: A prop wash effect analysis is no more or less speculative than any other analysis or modeling that is used to predict future events. The commentor submitted a prop wash analysis which showed that the top foot of sediment is vulnerable to prop wash. This was reviewed by the USACE which generally concurred with its findings. The prop wash analysis will be part of the Administrative Record.

Based on a review of PCB concentration estimates formulated by the Earth Vision software, elevated concentrations of PCBs are estimated to be near the surface between the Pennsylvania Avenue and 8th Street Bridges. With lower water levels in this area and little additional deposition likely to occur, prop wash effects will be a factor in achieving the target PCB sediment goal of 0.5 ppm.

2. The passage of recreational watercraft will not cause elevated PCB concentrations to be uncovered or resuspended.

"The evidence shows that propeller wash cannot reasonably be anticipated to expose and resuspend the elevated concentrations of PCBs that are buried beneath an average of four feet of sediment in the Inner Harbor."

Response: The prop wash analysis submitted by Tecumseh shows that sediments in the top foot are vulnerable to disturbances from recreational craft. Based on a review of all the sediment data in the Inner Harbor, when repositioned to account for bathyrnetry differences between the date of the sample and the most recent bathymetry in 1999, and using Earth Vision software to extrapolate PCB concentrations throughout the Inner Harbor, it is not necessary to disturb more than a foot or two of sediments to expose contaminated PCB sediments.

The comment further rationalizes the low risk of disturbing sediments by stating that there is a no-wake restriction in the Inner Harbor which would limit all vessels to low-throttle conditions. While there is a no-wake restriction in the Inner Harbor, it doesn't mean that boaters couldn't violate the restriction. This is similar to saying that since there's a 55 mph speed limit, no one drives faster than 55 mph on the roads.

“If prop wash or other physical forces posed a credible threat of resuspending several feet of sediment, as postulated by EPA, the results of such forces over time would have been physically evident in the core samples taken in the Inner Harbor. No such evidence has been observed.”

> ***Response: Three of the 4 core samples were taken well beyond the 8th Street Bridge where water levels are deeper and where you'd expect to see more sediment deposition over time. Not only are 4 samples wholly inadequate for characterizing the Inner Harbor, but only one core sample was taken between the Pennsylvania Avenue and 8th Street Bridges where physical forces do pose a credible threat in addition, all core samples were not analyzed for PCBs between the 2 foot and 5 foot depth Interval which is a signiflcant gap in the analysis.***

3. Future navigational dredging of the Inner Harbor channel is not reasonably anticipated.

> i. The historical conditions that led to initial navigational dredging of the inner harbor no longer exist.
>
> > ***Response: While this is likely true for commercial and industrial purposes, until the authorized navigation channel is deauthorized by the U.S. Congress it cannot be assumed that commercial/industrial navigational dredging will not occur. However, the dredging remedy recommended in the proposed plan was not based on a commercial or industrial use of the harbor. It was based on the largest recreational small craft that historically traveled in the harbor. The selected remedy for the Inner Harbor focuses on shallower side-to-side dredging primarily between the Pennsylvania Avenue and 8th Street bridges.***
>
> ii. Current and planned future land uses in the harbor area do not support EPA's proposed remedy.
>
> “...EPA's concern of the resuspension of PCBs from such watercraft traffic (from a proposed boat works) is unprecedented and unfounded, as discussed previously in these comments.”

Response: The comment describes a number of reasons why the City of Sheboygan will not develop a boat works facility upstream of the 8th Street Bridge, largely focusing on the rinancial hurdles the City must overcome. However, the City of Sheboygan has replaced the existing "fixed" bridge at 8th Street with a draw bridge, removing the physical barrier that limited larger boats from traveling upstream of 8th Street in the past. The Master Plan developed by the City of Sheboygan includes developing a boat works and replacing the 8th Street Bridge as just one step in the City's development.

Therefore, the concern of resuspension of PCBs by the largest recreational watercraft is not unfounded and, as discussed previously, the selection of a site remedy that includes watercraft disturbances may be unprecedented, but that doesn't make it inconsistent with the NCP.

iii. No basis exists to believe that the COE, the City, or private entities will undertake navigational dredging of the Inner Harbor within the foreseeable future.

A. The Army Corps of Engineers is unlikely to dredge the Inner Harbor in the foreseeable future.

Response: The U.S. EPA generally agrees with the comment. Due to the PCB contamination in the Inner Harbor and that no current commercial or industrial interest exists, the USACE is unlikely to dredge the Inner Harbor. But as mentioned previously, until the navigational channel is deauthorized by the U.S. Congress, the USACE remains responsible for navigational dredging if future uses of the harbor change.

B. Neither the City nor private organizations nor individuals are likely to dredge the Inner Harbor.

"Just as the City is not in a financially favorable position to take on a dredging project, the same can be said of organizations and individuals. ... Likewise, it is highly unlikely that an individual would have the resources to dredge the Inner Harbor."

> ***Response: The U.S. EPA agrees with the comment. Potential future uses include commercial development and the requisite resources to privately dredge.***

“Tecumseh certainly regrets the difficulties that low water conditions have created for recreational boaters throughout the Great Lakes, including the Sheboygan River. However, as discussed later in these comments, the desire of recreational boaters for navigational or maintenance dredging to occur at a third party's expense does not justify selection of a dredging remedy under CERCLA. Such a desire, no matter how loudly expressed, cannot enter into EPA's consideration of which remedial alternative best satisfies the remedy selection criteria under the NCP.

> ***Response: U.S. EPA generally agrees with the comment For the sake of clarity, U.S. EPA has revised the Inner Harbor remedy to “Lower River and Inner Harbor Sediment Removal Due to Natural and Recreational Impacts.”***
>
> ***The recommendation of the proposed plan alternative was <u>not</u> based on a desire to address navigational or maintenance dredging concerns expressed by local boaters. it wasn't until the public meeting that the U.S. EPA received any comments expressing concerns about navigability of the Lower River and Inner Harbor. The recommended alternative in the proposed plan was based on information available at that time which dealt with the anticipated impacts that recreational boating may have on resuspending PCB-contaminated sediments in the Lower River and Inner Harbor.***
>
> ***Additional Information concerning this issue has been received during the public comment period and has been thoroughly considered in selecting the Lower River and Inner Harbor remedy.***

D. Any future navigational dredging would be controlled and protective.

1. The federal permitting processes provides sufficient control and protection.

2. The state permitting process provides sufficient control and protection.

Response: Both of these comments assert that before any future dredging could occur in the Inner Harbor, both the federal and state permitting processes would provide sufficient control and protection of the PCB-contaminated sediment.

The U.S. EPA doesn't dispute that if followed, federal and state permitting processes could protect the environment from resuspension of PCBs. However, it is impossible to ensure that dredging or movement of PCB-contaminated sediments won't occur outside the federal and state permitting processes. It is the action, outside the formal process, that is likely to resuspend PCB-contaminated sediments.

An earlier comment noted the financial burden placed on any entity looking to dredge in the Inner Harbor. Because of this costly Financial burden, it is more likely that unregulated dredging or movement of PCB-contaminated sediments could occur.

3. EPA has justified its remedy selection in other cases on the protectiveness of the permitting process.

“... EPA has recognized that navigational dredging in and near remediation areas can be controlled and protective. In several cases, therefore, EPA determined that the same permit process that would apply to the Sheboygan River were sufficient to protect the integrity of natural recovery or capping remedies. For the Agency now to deviate from its previous stated positions, without a very good reason, would be arbitrary and capricious."

Response: The comment is correct that permits can act as effective Institutional Controls. The consideration of Institutional Controls can only come as a supplement to an active remediation. The NCP clearly states that "EPA expects to use institutional controls such as water use and deed restrictions to supplement engineering controls as appropriate

for short-and long- term management.... The use of institutional controls shall not substitute for active response measures (e.g. treatment and/or containment of source material, restoration of ground waters to their beneficial uses) as the sole remedy unless such active measures are determined not to be practicable, based on the balancing of the trade-offs among alternatives that is conducted during the selection of remedy." The remedy calls for an active response and in fact, relies on the institutional control of USACE permitting to prevent the harbor from being dredged to its authorized depth.

E. EPA is not authorized to require dredging that is primarily for navigational purposes.

"Remedial authority under CERCLA does not cover navigational or maintenance dredging. CERCLA authorizes EPA to conduct only those response actions that are necessary to protect human health and the environment for the risks of hazardous substance releases.

EPA has indicated that the Proposed Plan specifies dredging to 12 to 14 feet not only to allow room for backfilling with two feet of clean sediment, but to allow about 2 feet of additional backfilling to occur without impeding boat traffic. ... EPA is not authorized to prescribe over dredging to benefit local boaters; it serves no remedial function whatsoever."

Response: The elected remedy in the ROD does not include this 2 foot buffer to allow for additional backfilling without impeding boat traffic.

F. Dredging is likely to cause surficial concentrations to increase significantly.

Response: The selected remedy for the Lower River and Inner Harbor does not dredge down to the depths recommended in the proposed plan. Therefore, the possible resulting short-term surficial concentrations are not nearly as problematic as the comment suggests. In addition, implementation of the appropriate engineering controls will help reduce adverse short-term risks possible during implementation of a dredging remedy.

G. EPA has grossly underestimated the sediment removal volume and the associated cost and duration.

“EPA's underestimate of sediment volumes and related project costs and timing, and the Agency's overestimate of the PCB mass addressed in its proposal, substantially mis-characterizes the relative benefits, costs, and cost-effectiveness of the Proposed Plan. Given the potentially huge inaccuracies noted above, under no circumstances can EPA proceed to select a remedy for the Site until the Agency has revised its estimates and reevaluated their ramifications under the NCP.

Response: The sediment volume estimates were derived from an ARCVIEW-based program. The approximate boundaries of the navigation channel were determined and a 2 dimensional surface area was calculated. Volume estimates were then calculated using the average water depth for various areas of the Inner Harbor based on the low water datum point established by the USACE. The volume estimates were based on the 1979 bathymetty, which did not account for additional deposition since that time. However, at the time of the proposed plan the U.S. EPA was unaware of significant differences in bathymetry (deposition and scour) between 1979 and 1999. The sediment volume estimated to be removed also did not account for the sloughing of sediment that could occur with such a deep channel. Cost estimates at the RI/FS stage have an accuracy expectation of -30 percent to +50 percent and the U.S. EPA believes that the recommended proposed plan estimate fell inside that acceptable range.

During the public comment period the U.S. EPA was notified of apparent spreadsheet errors that where made in determining the cost associated with the recommended remedy in the proposed plan.

Based upon all of the new information obtained during the public comment period, the selected remedy for the Lower River and Inner Harbor is no longer a narrower deep channel remedy, but one that is a shallower and wider dredging approach to address just those sediment vulnerable to reasonably anticipated natural and human impacts. The concerns raised with regards to potential sloughing and volume increases are not significant under the current dredging remedy and spreadsheet errors previously noted have been corrected.

H. The proposed plan will disrupt the local community and the local economy.

“As discussed in the FS, a major dredging project in the Inner Harbor would disrupt local boating operations and tourism, with a negative impact on the local economy. More importantly, if EPA proceeds with an unjustified remedy for the

Lower River and Inner Harbor, litigation and its attended uncertainties, delays, and transaction costs is likely to engulf many businesses and public entities in the Sheboygan area. There is no health or environmental justification for the imposition of these costs and burdens.

> ***Response: The City has not expressed any concerns about the proposed Inner Harbor remedy having a negative impact on tourism or the local economy.***
>
> ***In addition, no comments or questions were presented at either the EPA's public meeting or the information sessions sponsored by the Lake Michigan Federation that indicated a concern over adverse impacts to the local community or economy by dredging part or all of the Inner Harbor. In fact a number of individuals at the EPA's public meeting expressed an interest in seeing more dredging done in the Inner Harbor. Except for this singular comment there doesn't appear to a public concern about dredging the harbor because of negative impacts to tourism and the economy. U.S. EPA does not agree that the remedy is unjustified.***

I. The Remedy Recommended in the FS Provides More Overall Protection of Human Health and the Environment and More Long- and Short-Term Effectiveness Than the Proposed Remedy at a Much Lower Cost.

Response: For the reasons previously noted, the U.S. EPA disagrees with the assertion that the FS-preferred remedy, natural recovery, provides more long-term effectiveness. Any dredging remedy will have the potential for greater short-term risks, but as mentioned earlier, these negative impacts can be effectively managed through the use of appropriate engineering controls. The U.S. EPA does agree that the FS-recommended alternative, natural recovery, will reach an acceptable PCB concentration in a reasonable time frame. Cost is only one of the nine criteria and does not override the other considerations.

J. The remedy recommended in the FS is preferred by the local community.

" Tecumseh received a total 177 comment cards and letters from local residents, all of which it has provided to EPA to be included in the Administrative Record. Of these comment cards and letters, 110 supported the recommended alternative in the April 1998 FS and 13 supported EPA's Proposed Plan. The remaining 54 are neutral, i.e., do not express support for either plan or contain questions. As EPA is well aware, when comment cards are provided to local citizens for purposes of encouraging comments on a proposed remedy, typically only negative comments are received. It is significant that we have received so many cards representing the usually “silent majority.”

The City apparently did not feel strongly enough about the Proposed Plan to provide a formal statement of position during the public comment period. At a minimum, this suggests that the City does not view the Proposed Plan as central to its future and is not unabashedly enthusiastic about the Proposed Plan.”

> ***Response: U.S. EPA performed a detailed analysis on all the comments submitted during the public comment period. We received ver 300 comments, which included comment cards submitted by Decision Quest, Proposed Plan comment cards, private letters, and email. Nearly 3/4 of all citizen comments where received via the Tecumseh comment cards, which showed a preference for the FS alternatives. This is not surprising since many of the comment cards were submitted in response to or referred to Tecumseh newsletters which were clearly in favor of the Tecumseh’s preferred alternatives and, as one commentor noted, that information and comment cards were distributed to Tecumseh employees via their time card slots. U.S. EPA questions whether the comment cards represent unbiased community input.***
>
> ***Comments submitted via the U.S. EPA Proposed Plan fact sheet generally took a neutral position and didn't necessarily endorse either the alternatives recommended in the FS or the Proposed Plan. Comments not submitted on either EPA or Tecumseh response cards showed a preference for more dredging than the U.S. EPA Proposed Plan.***
>
> ***A number of letters were received on behalf of groups/associations. Comments were received by the Sheboygan County Conservation Association, consisting of 32 clubs and representing 3,500 members, recommended that a "total clean-up" be performed. Comments were received from the Sheboygan Area Great Lakes Sport Fisherman calling for more dredging then proposed by the U.S. EPA. A letter received from the Sheboygan County Chamber of Commerce supported the alternatives in the FS. A letter received from the Sheboygan County Board of Supervisor's Resource Committee and Land Conservation Committee supported the U.S. EPA's Proposed Plan. Comments received from the Lake Michigan Federation urged the U.S. EPA to implement a more comprehensive remedy than outlined in the proposed plan.***

These letters on behalf of specified organizations, representing many individuals, and comments received, other than from Tecumseh comment cards, did not show a strong bias towards Tecumseh's preferred alternatives.

L2. Thomas Industries supports the preferred alternative (of natural recovery) identified in the April 1998 Feasibility Study for the Lower River/Inner Harbor.

Response: Comment noted

L3. The NRRB initially developed and selected a sediment trap as the recommended alternative for the Lower River/Inner Harbor. Subsequently, the USEPA developed a new recommended alternative, creation of a navigational channel. This alternative has been presented by the EPA with little supporting documentation. As noted above, Thomas Industries does not support either alternative.

Response: The U.S. EPA disagrees that the Proposed Plan alternatives were presented with little supporting documentation. The proposed plan Inner Harbor alterative was based on information available at that time. As noted In previous comments, the Record of Decision's Inner Harbor remedy has been revised based on information obtained during the public comment period. The administrative record will contain all the supporting documentation for the ROD's remedy.

L4. The U.S. EPA's Proposed Inner Harbor alternative is not an environmental remediation.

"The purpose of the proposed alternative appears to be an attempt to accommodate sailboat traffic in the Inner Harbor. Neither CERCLA nor the NCP authorize or permit the selection of remediation plans to promote navigation, recreation, or provide special benefits to the few owners of large deep keel sailboats."

Response: The recommended alterative in the proposed plan was not an attempt to accommodate sailboat traffic but to address adverse impacts to PCB-contaminated sediments from all recreational boats using the Inner Harbor. The selected Inner Harbor remedy does not promote navigation, recreation or provide special benefits to local boaters, but addresses the imminent and substantial threat that may result from the release of PCBs in the Inner Harbor due to natural and human Impacts.

L5. The U.S. EPA's alternative for the Lower River/Inner Harbor does not provide additional environmental benefits compared to the FS alternative.

Response: For all the reasons noted in previous comments regarding the inner Harbor, the U.S. EPA disagrees that the dredging in the Inner Harbor provides no additional environmental benefit as compared to the FS alternative - natural recovery.

L6. Sediment dredging projects at other locations have been unable to achieve the 1 ppm PCB concentrations that the U.S. EPA is targeting.

Response: Earlier removal activities at this site have successfully achieved residual PCB concentrations of 1.0 ppm or less. Concerns about short-term impacts and resuspension can be adequately managed through the appropriate engineering controls. In addition, since the selected remedy for the Inner Harbor focuses primarily on surface sediments, concerns over exposing the highest PCB-contaminated sediments is less of a threat.

Results from recent environmental remediation dredging projects demonstrate that minor short-term impacts of dredging are outweighed by excellent long-term environmental benefits. Benefits include mass removal of contaminated sediment and significant reductions in contaminant concentrations in remaining sediment, surface water and fish.

The table below lists several recent environmental dredging projects for which data on various environmental results are available. Although many projects don't have data for all parameters, the results available exhibit consistent trends. While most of these projects are in the Great Lakes Region, they are generally representative of environmental dredging in other areas.

Dredge Type	Project/Year/Primary Contaminants	Volume Removed (cubic yd)	Mass Removed (pounds)	Concentration Reductions		
				Sediment	Surface water	Fish
Dry	Ruck Pond, WI (1994) PCBs	7,700	785	NA	17x	9x
	Unnamed Tributary - Ottawa River, OH (1998) PCBs	8,000	56,000	-440x	NA	NA
	Bryant Mill Pond, MI (1998-99) PCBs	165,000	20,000	160x	NA	NA
	Willow Run, MI (1998) PCBs	450,000	440,000	-1,850x	NA	NA
Wet	Ford Monroe, MI (1997) PCBs	27,000	45,000	NA	NA	NA
	Sheboygan, WI (demo)(1989-90) PCBs	3,800	1,200	32x	NA	NA
	Black River, MI (1989-90) PAHs	49,000	NA	NA	6x	NA
	Shiawassee, MI (1982) PCBs	1,800	NA	18x	NA	6x
	Waukegan, IL (1992) PCBs	32,000	300,000	NA	NA	4x
	Manistique, MI (1995-ongoing) PCBs	73,000 (to date)	2700	4x	NA	NA
	GM, NY (1995) PCBs	13,800	NA	157x	NA	8x
	Lake Jarnsjon, Sweden (1993-94) PCBs	195,000	900	83x	3x	2x

L7. Natural recovery of sediment has been selected and successfully implemented at other sites, where environmental dredging was deemed infeasible.

> ***Response: Natural recovery has been selected for part of the Inner Harbor where the U.S. EPA reasonably expects additional sediment deposition and minimal natural and human impacts to sediments. Environmental dredging in the Inner Harbor has not been deemed infeasible, even by Tecumseh who developed the FS.***

L8. The US EPA cost estimate for the Lower River/inner Harbor does not include all costs and is significantly underestimated.

> ***Response: The U.S. EPA has acknowledged the calculation error and has corrected the spreadsheet . The estimated cost of the Lower River and Inner Harbor remedy also includes a line item for backfilling any excavated areas.***

L9. In lieu of creating a navigational channel, the local authorities could implement a maximum draft ordinance that would restrict boat traffic to recreational motorboats, and not large deep-keeled sailcraft.

Response: While this is possible, the U.S. EPA has no legal authority to require an ordinance on a public waterway that would limit its use. In addition, the City of Sheboygan or other local authorities have not expressed any willingness to limit use of the Inner Harbor.

L10. The US EPA alternative for the Lower River and Inner Harbor does nothing to improve the PCB concentrations in fish or the benthic population, beyond the natural processes which are included in the FS recommended alternative.

Response: The U.S. EPA disagrees. While the area between the 8th Street Bridge and the Inner Harbor mouth is anticipated to see additional significant deposition of low level PCB contaminated sediment, as mentioned in earlier responses, the area between the Pennsylvania Avenue and 8th Street Bridges is not expected to undergo much additional deposition and has been shown in the past to undergo a significant amount of scour which has exposed PCB-contaminated sediments up to 5 feet deep. The selected remedy for the Inner Harbor will remove PCB-contaminated sediment that is vulnerable to natural and human impacts, therefore, significantly improving the benthic community over the long-term.

L11. The benthic population in the Inner Harbor section of the river is already relatively healthy. Dredging for the navigational channel will in all probability negatively impact the benthic community in the Inner Harbor.

Response: The U.S. EPA acknowledges that dredging Inner Harbor PCB-contaminated sediments will have short-term adverse impacts on the benthic community. However, the selected remedy for the Inner Harbor will provide a healthier substrate for the reestablished benthic community.

L12. US EPA's alterative for the Lower River and Harbor will not shorten the time to lift the fish consumption advisory.

Response: This comment focuses on the fish consumption advisory for salmonids and the proportionate uptake of PCBs from the Sheboygan River vs. Lake Michigan. The U.S. EPA agrees that salmonids are likely to spend a significant amount of their life in the Sheboygan River. Therefore, remediation of the Sheboygan River PCB-contaminated sediments vs. natural recovery will likely result in similar fish advisory periods for salmonids. However, the focus of risk in the Sheboygan River is small mouth bass and other resident fish. For these aquatic receptors, and the wildlife and humans who eat resident fish, removal of PCB-contaminated sediments that are reasonably anticipated to be disturbed by natural or human impacts would be expected to shorten the time to lift fish

consumption advisories over natural recovery as recommended by the PRPs.

L13. Recent (May 1999) sediment data in the Inner Harbor confirms that PCB levels in sediments are decreasing, therefore disturbing over 100,000 cubic yards of sediment is not justifiable.

Response: As noted in a previous comment the number of samples taken is wholly inadequate to accurately estimate the average PCB concentration for the entire Inner Harbor. Only 4 of the May 1999 sampling locations are near sampling locations taken in 1987 and one of the samples obtained in 1999, SD-4, is between two 1987 sample locations (H15 and H16). Therefore, only 3 of the 14 samples are close to or at the same sampling location as samples taken in 1987 making any determination of trends for the entire Inner Harbor questionable.

The three samples taken in 1999 that are near the 1987 sample locations are well beyond the 8th Street Bridge where you'd expect to see more signiflcant reductions In surficial PCB concentrations based on the bathymetry analysis. Of the 6 surface samples taken in 1999 between the Pennsylvania Avenue and 8th Street Bridges, only one sample, at 0.76 ppm is near the target goal of 0.5 ppm. The remaining 5 surface samples range from 1.1 to 5.3 ppm and are located in areas that are not expected to see much additional deposition by cleaner upstream sediments.

L14. It appears that a project depth of 12 feet would be sufficient for the current use of the Inner Harbor. Project de-authorization or modification of a portion of the harbor from the current authorized project depth of 21 feet to Maryland Avenue and 15 feet to Jefferson Avenue is an option that could be considered. With de-authorization of the Inner Harbor, any maintenance dredging work would become the sole responsibility of the local sponsor. In addition, the proposed clean-up work would render the harbor virtually non-viable for any future commercial growth of the Inner Harbor.

Response: The U.S. EPA does not have the authority to de-authorize or modify a portion of the current authorized depth. A local sponsor would have to petition Congress to de-authorize or modify the current authorization. The City of Sheboygan has expressed, verbally, on a number of occasions to U.S. EPA representatives that they are not interested in any de-authorization of the harbor.

L16. The proposed plan does not address whether the US EPA will assess the clean fill once in place to determine if the PCB concentrations are higher or lower than current shallow sediment concentrations.

Response: Any sediments used as backfill will be sampled prior to placement in the harbor. Sediments used as backfill wouldn't be used if they are over the current sufface sediment concentrations.

L17. The Sheboygan Area Great Lakes Sport Fisherman believe that the middle of the river from Pennsylvania Ave. bridge to the New Jersey Ave. bridge is a navigational hazard and contains numerous PCB hot spots (< 10 ppm). We request dredging 14 feet of sediment from the middle of the river to eliminate this health hazard and restore the river to a usable state.

Response: The U.S. EPA must select a remedy that addresses human and ecological threats and cannot address navigational hazard concerns alone. The Natural Resource Trustees have the authority to address navigational issues along with other restoration issues associated with the resource.

L18. Will the lower river and harbor ever be able to be dredged in the future if Tecumseh's plan is adopted?

Response. Yes. Regardless of which Inner Harbor alternative is selected, future dredging of the Inner Harbor will not be prohibited under the U.S. EPA remedy. Any future dredging in the Inner Harbor will require the same permitting process as is currently required by the Wisconsin Department of Natural Resources and the USACE.

L19. If the PCB-contaminated sediment is four feet under the surface couldn't the PCB's be removed with siphon dredging leaving the clean sediment in place to stop PCBs from contaminating the river while cleaner fills continues to be deposited?

Response: Current information indicates that there isn't a four foot layer of clean sediment at the surface between the Pennsylvania Avenue and 8th Street Bridges. This generalization is more appropriate for sediment between the 8th Street Bridge and the Inner Harbor mouth. The EPA is not currently proposing to dredge much past the 8th Street Bridge. In addition, if Inner Harbor data shows that the first few feet of sediment is generally near the sediment target of 0.5 ppm, then an approach similar to your recommendation may be appropriate to remove "hot spots" under the surface.

L20. The EPA's plan for dredging at the Lower River and Inner Harbor will cause significant and unnecessary disturbance to recreational and the river's ecosystem, with little to no benefit.

Response: The U.S. EPA disagrees. An average PCB concentration of 0.5 ppm is necessary to address human health and ecological risks. While

current information on the Lower River tells us that we may already be near or below this target, PCB concentrations in the Inner Harbor are still above this level. An analysis of deposition trends in the harbor indicate that there won't be much more deposition between the Pennsylvania Avenue and 8th Street bridges. Therefore, the U.S. EPA cannot reliably depend on deposition of cleaner sediment to cover the PCB-contaminated surface sediments in this part of the harbor. While PCB concentrations near the surface are less than those deeply buried they still pose an unacceptable risk. Before implementation of any dredging in the Lower River or Inner Harbor the sediment will be re-characterized to assist in defining where dredging is needed. Based on current information it is likely to take the form of hot spot removal in the Lower River and surface sediments in the Inner Harbor between the Pennsylvania Avenue and 8th Street bridges. All excavated areas will be covered with clean sediment. This new cover will create a healthy substrate for the benthic community resulting in reduced fish tissue levels over time.

L21. If the PCBS are already covered by 4 feet of sediment, what can be gained by disturbing the river bed and where will the affected sediments be deposited and how can we be sure additional problems will not be created.

Response: The four feet of cover referred to is also contaminated with PCBs. Removal of PCB-contaminated sediment is necessary to reduce excess risks to fish in the river and humans who eat the fish. An excavated sediment will be placed in an WDNR approved in-state or out of state landfill authorized and licensed to accept the sediment.

L22. This portion of the river does experience PCB contamination and is highly utilized by the boating community. With the drop in water level in Lake Michigan, the problem of PCB contamination exposure increases, due to boats stirring up the sediment. EPA should address this section of the river more aggressively than what is called for in the proposed plan.

Response: The U.S. EPA agrees that lower water levels and boat traffic have the potential of stirring up PCB-contaminated sediment. The selected remedy for the Lower River and Inner Harbor is to remove sediments that are vulnerable to disturbance by boaters and high flow events.

L23. Tecumseh Corporation says that the contaminants in the Lower River are covered by sediments. Supposedly 4 to 5 feet of sediments cover the contaminants. If this much sediment is being deposited in the Lower River, it will eventually have to be dredged to make it useable. Presently this cannot be done because of the presence of PCB's. I cannot afford a “large" boat, but do have a smaller boat which I occasionally use. Larger boats right now, whether traveling or docking, are kicking up sediments and stirring them around. If these sediments which are covering the contaminants are being kicked up, stirred around, and washed down the river with the current; it seems possible that these PCB's could also be disturbed and stirred up.

Response: The 4 to 5 foot cover referred to by Tecumseh also contains PCBs at levels which cause an acceptable risk. The selected remedy calls for the removal of contaminated sediments vulnerable to disturbance by boats and high flow events.

L24. The affected sediments in the Lower River and Harbor are buried by an average of four feet of cleaner sediments. Modeling has demonstrated that these sediments are stable.

Response: Again, while PCB concentrations near the surface are generally less contaminated than sediment buried many feet below, they continue to be and are expected to remain above acceptable risk levels between the Pennsylvania Avenue and 8th Street bridges. A review of sediment bed changes over the last 20 years shows that scour up to 5 feet has occurred between the bridges. It's unclear what modeling is being referred to, but the inference is that the contaminated sediment isn't going anywhere. That is untrue based on actual sediment bed measurements in the harbor. The U.S. EPA selected remedy will remove those surface sediments which still present an excess risk, are vulnerable to boating and flooding, and are not unlikely to be buried by less contaminated sediment.

<u>Floodplain Soil</u>

FS1. Tecumseh was not allowed to participate in the planning or implementation of the TERA.

Response: Tecumseh was offered, and declined, the opportunity to perform the ecological risk assessment at the site.

FS2. The TERA used these few biased samples to infer risks for the entire 3-mile stretch of floodplain in the Upper River rather than quantifying risk for specific floodplain areas.

Response: This is incorrect on both counts. The risk estimates apply only to those segments of the floodplain previously identified as being contaminated with elevated soil PCB levels (TERA Sections 4.2.2, 6.3 and 6.6). Area-specific risks are discussed in Section 6.7.

FS3. Comments on the EPA's TERA exposure and risk assessment methods

a. The TERA overstates risk due to its reliance on a biased data set.

p. 63 - 64. "...samples were biased towards areas having soil PCB concentrations greater than 10 ppm, while lower PCB soils were excluded from the analyses. As such, the data are not representative of PCB concentrations in the entire floodplain and are therefore not representative of reasonably anticipated PCB exposures."

> ***Response: On-site floodplain sampling was performed only in floodplain segments previously identifiled as having elevated PCB levels because these are the likely areas requiring remedial action if ecological risks occur. An assumption was made that areas with lower PCB levels would be unlikely to require remedial actions, and therefore did not justify additional investigation. Also, since an important purpose of the sampling was to obtain PCB bioaccumulation estimates from soil to earthworms, areas of elevated PCBs were targeted to avoid non-detections in the data that would complicate or prevent calculations of site-specific bioaccumulation factors (Section 4.2.2).***
>
> ***No attempt was made to represent exposures over the "entire floodplain" because robins (and other vermivores) do not individually forage over the entire 3-mile upper river floodplain, and therefore do not receive integrated exposures over the entire area. The appropriate scale for estimating exposures is one commensurate with robin foraging area, which is smaller than the entire upper river floodplain, and is smaller than any individual floodplain segment as defined by previous investigations.***

p. 64 "By focusing exclusively on high-PCB locations and failing to account for the fact that exposure (i.e., robin foraging) is equally likely to occur in low PCB areas, the TERA overstates potential ecological risks posed by floodplain soils."

> ***Response: The TERA did not focus exclusively on high-PCB locations or fail to account for robin foraging in areas with lower PCB concentrations. The effects of foraging over areas with spatially heterogeneous soil PCB levels were assessed in Section 6.5, in which exposure was integrated over sub-areas with mean soil PCB levels ranging from 0.3 to 25 ppm, and in Section 6.7, in which risks were separately assessed for individual soil sample locations reported in ASRI (1995).***

p. 64. "The TERA calculated a potential risk for the entire floodplain stretch, rather than recognizing the large spatial heterogeneity in soil PCB concentrations and focusing on specific floodplain sections where the soil and earthworm samples actually were collected. EPA calculated a single Hazard Quotient ("HQ") for robins for the entire stretch of floodplain, and used a single value for mean PCB concentrations for soil and earthworms."

> ***Response: The risk estimates apply only to those segments of the floodplain previously identified as being contaminated with elevated soil PCB levels, and do not apply to the "entire floodplain stretch". In other words, the HQ based on mean soil and earthworm data represents the mean risk to robins with foraging areas located in those floodplain areas with elevated soil PCB levels. Although this is stated in several places in the draft TERA (Sections 4.2.2, 6.3 and 6.6), the table, figure, and section headings have been modified to state that the data are for "targeted floodplain segments" to ensure clarity.***
>
> ***The spatial heterogeneity was addressed by two approaches with similar results (Sections 6.5 and 6.7).***

p. 64 "A better approach would have been to calculate HQs for each sampling area. ... Tecumseh's calculation of sample-specific HQs (based on the data and assumptions used in the TERA) result in a wide range of HQ values (0.1 to 154). This large range demonstrates that ... there are certain areas of the Upper River floodplain that clearly pose insignificant risks under baseline conditions."

> ***Sample-specific risk estimation is an alternative approach, but this does not change the findings in any manner. The distribution of sample-specific HQs is as or more important as the range. In fact, all but one of the on-site sample-specific HQs exceed 1, and most substantially so, which demonstrates that all but one of the on-site floodplain samples may pose risks to vermivorous wildlife. In contrast, the concentration at the reference sample location is orders of magnitude lower than levels of potential concern.***
>
> ***The TERA explicitly states that risks to wildlife are unlikely in floodplain segments with low levels of soil PCBs (Summary and Sections 6.4 and 6.6).***

b. The TERA fails to accurately account for the non-earthworm portion of the robins diet.

> ***Response: p. 65 "Other potential exposure pathways were not incorporated (i.e., incidental soil ingestion)."***

As discussed in Section 4.3.3, a portion of the expected soy ingestion is included in the earthworm data because the earthworms were undepurated, that is, they were analyzed with their gut contents. Earthworm gut contents may be as much as 30 percent of their live weight if as little as one-third of the gut contents consists of soil, this would account for the reported dietary soy content for the highly vermivorous woodcock. Inclusion of an additional incidental soy ingestion would incrementally increase the risk estimates and incrementally decrease the calculated protective soil levels, but would not significantly affect either result

p. 65 "Concentrations of PCBs for non-earthworm invertebrates were estimated based on a literature study concerning dioxin concentrations in invertebrates and earthworms sampled from pine tree plantations subject to paper sludge applications. Use of the data from this study is highly uncertain, as historically deposited PCB residues in floodplain soils have lower bioavailability than dioxins in the subject study, and pine tree plantations are not representative of vegetative cover types present in floodplains along the Sheboygan River."

Response: As discussed in Section 4.3.2, the paper sludge dioxin study was not used to directly predict PCB uptake in non-earthworm invertebrates, rather, the ratio of dioxin uptake in earthworms vs. other invertebrates was used to predict other invertebrate PCB uptake from measured earthworm PCB uptake. The difference in vegetative cover between the studies is irrelevant since the focus is on relative, not absolute, accumulation among different categories of invertebrates.

p. 65. "A more accurate and simple approach would have been to collect other invertebrates during the soil and earthworm sampling events. These data are critical given the high percentage of non-earthworm invertebrates in the assumed robin diet."

Response: The suggested research is unwarranted because the net result of the non-earthworm modeling exercise was only a 20 percent contribution to the estimated robin exposure to floodplain PCBs. Refinement of this value would have only minor effects on the final risk estimates.

p. 65 "Other potential exposure pathways were not incorporated (i.e., incidental soil ingestion)."

Response: As discussed in Section 4.3.3, a portion of the expected soil ingestion is included in the earthworm data because the

earthworms were undepurated, that is, they were analyzed with their gut contents. Earthworm gut contents may be as much as 30 percent of their live weight. If as little as one-third of the gut contents consists of soil, this would account for the reported dietary soil content for the highly vermivorous woodcock. Inclusion of an additional incidental soil ingestion would incrementally increase the risk estimates and incrementally decrease the calculated protective soil levels, but would not significantly affect either result.

c. The TERA used inappropriate biomagnification factors to assess exposure.

p. 65 "The diet-to-egg biomagnification factors used in the TERA are based on data for fish-eating birds which are inappropriate for robins. The bioavailability of PCBs in fish may be much different than the bioavailability for robins."

Response: These are suppositions unsupported by any kind of evidence. The estimated risk in terms of lowest observed adverse effect level hazard quotients (LOAEL-HQs) are closely similar for total PCBs modeled to eggs and modeled as oral dose to adult birds (10 and 8, respectively). The LOAEL-HQ is also closely similar for PCB congener-specific modeled doses to eggs (6 to 10) (Appendix D.2) (congener-specific oral dose risks could not be calculated because of a lack of toxicological studies for this exposure route). This indicates that the use of piscivorous diet-to-egg BMFs for robins does not result in inconsistent risk estimates compared with oral ingestion-based estimates. Although the dioxin-based risk estimates were more variable (3 to 20 for oral dose and egg modeling, respectively), they bracket the total PCB and PCB congener-specific risk estimates, again lending confidence to the results. The only outlier is the TEQ-based oral ingestion dose risk estimate (120), which, if valid, would indicate an order-of-magnitude lower protective soil PCB levels. Weight-of-evidence supports a LOAEL-HQ approaching a value of 10, and does not indicate significant or systematic distortions due to the use of piscivorous diet-to-egg BMFs.

p. 65 "A more appropriate and direct approach would have been to collect robin eggs from areas in the Sheboygan River floodplain and analyze the eggs for PCBs."

Response: Agreed. It would also be more appropriate and direct to perform egg injection studies with robin eggs to derive species-specific toxicological benchmarks. It would also be more appropriate and direct to study reproductive, hatching, and nesting

success in the field. This would necessarily entail detailed study of spatial feeding patterns, spatially-segregated PCB analyses of prey items and associated soils (to translate findings to protective soil levels), and the contribution of other stressors to reproductive/nesting endpoints. This would still leave open a question regarding population-level impacts, since the overall impacts of changes in reproduction, hatching or nesting may be modified by density-dependent mechanisms and interspecific interactions. The latter study would necessarily entail a multi-season project to account for annual variability in robin population dynamics (requiring several years to as much as a decade to provide valid variance estimates), and to separate confounding effects and interactions. The point being that all field studies and modeling efforts have uncertainties associated with them that could be addressed by further studies, which in turn reveal other uncertainties. The decisions whether and how far to proceed with further investigations are management and policy questions.

d. The TERA used inappropriate toxicity reference values (TRVs).

p. 66 "...chickens were fed PCB-containing carp collected from the Saginaw River. However, other constituents including pesticides were also present in the carp tissue, and it is unlikely that PCBs were the sole causative agent of observed effects."

Response: This supposition is not supported by the data. Pesticide levels in Saginaw carp are reported in Resturn, et al. 1998. Whole-fish total PCB concentrations are 2 to 5 orders of magnitude (100 to 100,000 times) greater than pesticide concentrations. Of 18 pesticides analyzed, over 80 percent were less than 10 ppb (over 40 percent were less than 1 ppb). Only 3 pesticides exceeded 10 ppb: p,p'-DDD (92 ppb), o,p-'DDE (42 ppb), and o.p-'DDD (24 ppb). These are 2 orders of magnitude lower than the dietary concentration shown to cause egg shell thinning in kestrels (LOAEL of 3,000 ppb DDE), and an order of magnitude lower than the dietary NOAEL (300 ppb) (Lincer 1975). Pesticide-related adverse effects are therefore highly unlikely, especially since raptors are more susceptible to DDE than chickens.

The Saginaw carp also contain trace amounts of chlorinated dioxins and dibenzofurans several orders of magnitude less than PCB levels (Restum, et al. 1998), but the same is true for Sheboygan sediments so, in this respect, use of toxicological benchmarks based on

Saginaw carp feeding studies is particularly appropriate for assessing risks at Sheboygan.

p. 66 "...chickens are known to be extremely sensitive to the effects of PCBs, and using chickens as surrogates for robins is likely to significantly overestimate potential risks to robins."

> ***Response: Interspecific extrapolation uncertainty factors were not used in the TERA because chickens are known to be highly sensitive to PCBs. As discussed in Section 4.4.2.1, the egg toxicity reference value (TRV) based on the carp-fed chicken study is actually somewhat higher than the lowest egg PCB concentrations associated with adverse effects in field studies of several wild bird species (bald eagle, common terns and Forster's terns), which demonstrates that the value is not overly conservative (not likely to over-estimate risk). Also, the relative sensitivity of robins and chickens to PCBs is not known since no toxicological studies have been performed with robins. It is only assumed that robins are no more, or possibly less, sensitive than chickens because chickens are the most sensitive of the relatively few species studied for PCB effects in a laboratory setting.***

> ***Several aspects of the TERA may have resulted in underestimation of risk including a much lower robin ingestion rate than conventionally used in USEPA risk assessments, and selection of TRVs that were not necessarily the lowest available in the literature. The back-calculated soil PRGs may have been too high because of use of a high estimate for robin foraging area (compared with other available literature) and use of the mean soil-to-earthworm BAF instead of the upper 95 percent confidence level estimate of the site-specific BAF (Section 7.2).***

p. 66 "TRVs obtained from an injection study [dioxins] may vastly overstate the effects caused by the same exposure level incurred via the diet. ... Therefore, it is highly inappropriate to use data from an injection study to estimate the potential effects of an oral (dietary) exposure."

> ***Response: Risks were calculated on a dioxin basis as part of a weight-of-evidence approach in addition to calculating risks on a total PCB basis and on a PCB congener-specific basis. Only the total PCB and PCB congener-specific models and data were used to back-calculate ecologically protective soil PCB levels. The dioxin-based risk estimates were used for comparative purposes only, and were not relied on to make recommendations for the site.***

e. The TERA inadequately quantifies potential population-level effects.

p. 66 "... the overall endpoint for ecological risk assessment, as defined in EPA guidance, is typically population-level effects rather than individual level effects. Limited literature available on this subject suggests that NOAEL-based HQ values of 10-20 would be the minimum associated with population-level effects on birds (Bowerman et W., 1995)".

> ***Response: The program-specific guidance for Superfund ecological risk assessment states the following (USEPA 1997):***
>
> ***"Ecological effects of most concern are those that can impact populations (or higher levels of biological organization). Those include adverse effects on development, reproduction, and survivorship.***
>
> ***The reproductive endpoints used in the TERA are consistent with the Superfund guidance.***
>
> ***The TERA calculated risk both on the basis of NOAEL and LOAEL. The rounded NOAEL-based HQs range from 10 to 50, and 20 to 80, for mean and upper 95 percent confidence level exposure scenarios, respectively, for egg dose modeling; and from 30 to 70, and 50 to 120, respectively, for oral dose modeling (excluding the oral dose TEQ which give order-of-magnitude higher risk estimates) (Appendix D.1). According to the reference cited in Tecumseh's comments, these levels of risk may be expected to result in population-level effects. The suggested interpretation of the NOAEL-HQ values as likely to result in population-level effects will be incorporated in the final TERA.***

f. The TERA lacks adequate field verification of predicted exposure and effects.

p. 66 - 67 "A fundamental flaw of the TERA is its lack of field verification. ... For example, non-earthworm insects ... could have been collected and analyzed for PCBs ... Robin eggs could have been collected ... allowing for a direct measure of PCB concentrations."

> ***Response: The purpose of the field effort was to provide site-specific data on earthworm bioaccumulation of soil PCBs. This important source of model uncertainty was field verified The effort and cost of collecting field data on non-earthworm invertebrate bioaccumulation of PCBs is unjustifiable because the models show that this component contributes only 20 percent of the PCB dose to***

robins. Refinement of this estimate would have only minor effects on the final results.

Robin eggs are not available in late autumn at the time the field data was collected in any case, the field effort was the first to sample terrestrial biota specifically for floodplain ecological risk assessment purposes, and it would have been an irresponsible expenditure of time and money to locate, collect and analyze bird eggs before it was known whether or not vermivorous birds were potentially at risk. Now that the fleld-verifled earthworm bioaccumulation of PCBs has been shown through models to present risks to robins (and, by extension, other vermivores), further investigations may be considered to reduce modeling uncertainties. The time, effort, and expense of further studies need to be balanced against the likely change in results. In order to relate the results of egg analyses to soft contaminant levels, an egg study should include detailed mapping of foraging locations by breeding pair, with co-located prey and soil analyses. Without this additional information, the results of an egg study could not be used to calculate ecologically protective soil concentrations. It would require a major field effort to produce useable and defensible data.

p. 67 "While field verification of effects is somewhat more difficult, direct measure of toxicity or other adverse effects using field-collected robin eggs also could be conducted."

Response: The proposed study would require a substantial field effort, as discussed in the previous response for exposure verification, with the additional efforts to perform histopathology and to document all causes of egg mortality including predation. In addition, since shrew feeding habitats and prey selection differ from those of robins, a parallel study would need to be implemented to provide field verification of effects on mammalian vermivores.

p. 67 "The lack of field verification undermines the usability of the TERA as a basis for remedial decisions."

Response: There is no requirement that <u>every</u> component of a risk assessment must be field-verified before it can be used for decision-making purposes. The program-specific guidance for Superfund ecological risk assessment states the following (USEPA 1997):

> ***"While population/community evaluations can be useful, the risk assessors should consider the***

level of effort required as well as the difficulty in accounting for natural variability.

"Although population- and community-level studies can be valuable, several factors can confound the interpretation of the results. ... Failure to evaluate such issues can result in erroneous conclusions. The level of effort required to resolve some of these issues can make population/community evaluations impractical in some circumstances."

The TERA is based on field-verified earthworm bioaccumulation of PCBs, field-collected data on distribution of floodplain soil PCBS in contaminated segments, modeled exposure, and literature-derived toxicity values. The uncertainties in the latter two components may be reduced by further studies, but the decision to proceed with further studies should be based on careful consideration of the scale of effort, expense, and likely time requirements.

FS4. Comments on the TERA methods for spatial averaging PCB data

a. The TERA uses inappropriate area-weighting methods to compare mean PCB concentrations to ecological PRGS.

p. 67-68 "USEPA (1999a) reported a mean PCB concentration of 25.3 ppm (based on data from FPR-3, FPL-4, FPR-5, FPR-6, FPR-7, FPL-8 and FPL-11) as being representative of the entire floodplain, from the River's edge to 100 ft inland, in this section of the River. ... There are, however, significant floodplain areas along the 3-mile stretch that have much lower PCB concentrations ... EPA's averaging of the high PCB concentration data from a few areas misleadingly inflates the overall floodplain soil PCB concentration. ... It is unclear why EPA arithmetically averaged PCB concentrations over such a large stretch of floodplain rather than looking at specific areas."

Response: The TERA nowhere states that the mean concentration for segments previously identified as having elevated soil PCB levels is representative for the entire upper river floodplain, and explicitly states in several places that there are areas with lower concentrations. The purpose of averaging the discrete soil data by distance interval from river (using corrected, actual distances from the river instead of the misleading distances presented in the Alternative Specific Remedial Investigation which claimed to be distances from the river but were actually transect distances) was to

demonstrate and assess the horizontal spatial differences in soil PCB concentrations with increasing distance from the river in the segments known to have elevated soil PCB levels. This was necessary because previous reports obscured the spatial patterns by providing a misleading description of the sample distance information, and by averaging soil concentrations over the entire floodplain width instead of analyzing spatial patterns. The spatial data show that elevated floodplain contamination is primarily confined to less than 100 ft of the river bank, and that levels in the 100- to 300-ft intervals from the river are substantially lower. Therefore, averaging concentrations over the entire 300-ft width of the floodplain misleadingly deflates the concentrations likely to be encountered by ecological receptors foraging near the river in the segments in which discrete sampling was performed

The TERA also assessed specific areas by considering the risks associated with <u>each</u> of the individual polygons used for the SWAC calculation in the FS (in some cases risk was assessed for combinations of adjacent polygons when the combined areas were appropriate for robin foraging, but in most cases, a single polygon sufficed for one or more robin foraging areas).

p. 68 "The revised FS (BBL, 1998) presents a more appropriate area-specific weighting of PCB concentration (<u>i.e.</u>, surface-weighted-average-concentration, SWAC) to estimate potential exposure to floodplain soil PCBs."

Response: The total areas over which the SWAC's were calculated are incommensurate (much larger) than the foraging areas of vermivorous ecological receptors, and are therefore inappropriate for estimating exposures to these receptors.

b. It is inappropriate to adjust SWAC to the assumed robin foraging areas as the TERA did.

Response: The first comment under this heading criticizing the robin foraging area values is repeated in the next section, and is addressed there. Most of the remainder of the comment is a defense of calculating SWAC over the entire width of the floodplain without consideration of the likely spatial pattern of exposure to ecological receptors. EPA's position is that SWAC's calculated over areas greater than the expected exposure areas are invalid for estimating exposures to ecological receptors, particularly when contaminant levels vary in a nonrandom pattern as they do in the Sheboygan floodplain with distance from the river. The concluding comment on

the post-remedial SWAC values is repeated in Comment F, and is addressed there.

p. 68 - 69 "Sample locations used in SWAC's were all within 300 ft of the River (within the 10-year floodplain), and thus subsequently fall within EPA's assumed fledgling-stage foraging area."

Response: However, when the distances parallel to the river over which the SWAC's were calculated are considered, the individual SWAC areas are 2 to 6 times larger than robin fledgling-stage foraging area, and 10 to 35 times larger than robin nestling-stage foraging area (Section 6.7). An integrated exposure estimate calculated over an area as much as an order of magnitude greater than the expected receptor foraging area does not provide useful information for estimating risk to those receptors.

FS5. Comments on Upper River foraging habitat and general habitat quality

a. The TERA's robin foraging assumptions are not supported and are inappropriately used to define risk.

p. 69 "There are no studies on robin habitat and foraging areas along the Sheboygan River. ... Reliance on [one] study alone to determine robin foraging areas is inappropriate as the Weatherhead and McRae (1990) study objectives and habitat differ from those of the Sheboygan River."

Response: Several studies of foraging and territory size were considered. Weatherhead and McRae was selected because it provided information on foraging and not just territory, showed changes in foraging areas as development of young progresses, and showed the geometry of the areas. The territory sizes given in four other robin studies summarized in USEPA (1993) are 0.11, 0.12, 0.21, 0.21 and 0.42 ha, compared with 0.15 ha for nestling-stage foraging area and 0.81 ha for fledgling-stage foraging area based on Weatherhead and McRae. If anything, the Weatherhead and McRae fledgling-stage estimate may be non-conservative, that is, too large therefore resulting in underestimation of potential exposure to spatially-patterned soil contamination. Use of the full available literature data set would result in smaller foraging area estimates and correspondingly higher risk estimates than reported in the TERA.

p. 69 - 70 "Information of foraging areas used by adult robins caring for nestlings and fledglings [in Weatherhead and McRae 1990] was presumably obtained from the author's observations of parents and fledglings. However, it appears that adult robin observations were only made in relation to fledgling identifications, and it is probable that not all adult foraging activities were documented. Furthermore, the study indicated that observations were likely to be impeded by dense vegetation. Overall, the accuracy of adult home ranges based on the Weatherhead and McRae (1990) study is highly uncertain."

> ***Response: The methods used for foraging area determinations are described in Weatherhead and McRae (1990). All adult robins were caught and color-banded. Foraging observations were not made by the authors' observations as presumed in the comment, but were made by other researchers who "regularly walked through the study area and mapped the location and identity of every robin they saw" (Weatherhead and McRae 1990). These observations were made "nearly every day of the study", which ran from late April to mid-August in 1987 and 1988, and were collected "over all daylight hours". Home ranges were calculated for 24 parents with sufficient observations for both nestling and fledgling stages. The resulting estimates have high precision: mean nestling-stage foraging area of 1472 ± 205 m^2, and mean fledgling-stage foraging area of 8080 ± 1319 m^2 (± SE). Nearly 90 percent (21 out of 24) of the individual comparisons showed a consistent difference between the nestling- and fledgling-stage foraging areas. Contrary to the claim that the accuracy is "highly uncertain", the estimates have an impressive degree of precision and internal consistency. This would not occur in a study of two year's duration with a relatively large number of observed pairs if the techniques were unreliable.***

p. 70 "... it appears that [Weatherhead and McRae 1990] robin data were gathered from the mature forested area only. This is unlike the majority habitat present along Sheboygan River, which predominantly consists of smaller tracts of deciduous forest surrounded by open fields and residential areas."

> ***Response: This is a good argument that the foraging area estimates based on Weatherhead and McRae (1990) may be larger than appropriate for application at Sheboygan with more favorable robin habitat, which indicates that the exposures to robins and risk estimates in the TERA may be too low (non-conservative).***

b. Site-specific habitat information demonstrates that the TERA's assumptions and conclusions are inaccurate.

p. 70-72. "The following presents habitat information collected by Tecumseh that suggest robin-foraging assumptions used by EPA in the TERA are not supported by site-specific habitat data, and it is likely that robins do not preferentially forage in areas immediately adjacent to the River. ... Wauer (1999) suggests that robins often utilize common feeding grounds such as lawns, golf courses and pastures. This type of short-grass foraging habitat is not characteristic of the vegetative cover along the floodplain immediately adjacent to the Sheboygan River. ... The areas in which [elevated floodplain PCBs occur] are predominantly wooded areas with mature trees, rather than the pastures and fields in which robins prefer to forage. ... Furthermore, all of the floodplain areas indicated to have PCB soil concentrations greater than 10 ppm are immediately surrounded by, or near, areas of mowed fields, residential areas, pastures and/or golf courses where robins would be expected to forage preferentially. During a recent site visit (July 1999), robins were only observed foraging in an open pasture across from FPR-5. Robins were also observed flying over the River to a residential and mowed field area near FPR-6. ... it is also very probable that robins feed in areas further from the River where better foraging habitat (field, pastures and golf courses) is available and where PCB concentrations are lower."

> ***Response: Observations made in a short (unstated) period in July do not make a supportable case that robins do not feed on earthworms within 100 ft of the river bank. Neither diurnal or seasonal utilization patterns are discussed, and the reproductive stage of the observed birds is unknown. For example, when observations were made, the majority of robins may have been past the nestling stage, when they feed preferentially nearest the nest (except for pairs that may have made a third nesting attempt).***
>
> ***During the sampling for the TERA, earthworms were plentiful and easily collected at all of the on-site locations. It is inconceivable that no avian or mammalian vermivores are feeding on these worms. If robins do not feed under mature hardwoods, then the robins in the Weatherhead and McRae (1990) study would have starved or emigrated. More to the point, robins are the measurement endpoint for the TERA. This does not mean that robins are the only species under consideration. The assessment endpoint for the TERA is "reproductive performance in terrestrial vermivorous and insectivorous species" (Section 3.3), and the measurement endpoint (robins) "serves as a proxy for a half-dozen or so additional bird species, a similar number of mammalian species, eight amphibian species, four reptilian species, and numerous vermivorous invertebrate species" (Section 3.4) potentially utilizing the Sheboygan floodplain. It would take a substantial field effort to reliably demonstrate that no birds, mammals, amphibians or reptiles are feeding on earthworms in the contaminated floodplain segments***

within 100 ft of the river - a study which is not recommended because the premise lacks ecological plausibility.

Even if the argument that the near-river earthworms are without predators because of habitat limitations could be supported (despite its inherent implausibility), the floodplain habitats will change over time due to natural and anthropogenic processes, so there is no assurance that these "protective" conditions will persist.

p. 71"... the EPA assumed that robins forage preferentially within 100 and 300 ft of the River, and found that robins that forage with [sic] 100 ft of the River are at potential risk for reproductive effects."

Response: This is an incomplete representation of TERA findings. Robins with foraging areas that extend from the river bank to 300 ft of the river are also at risk of reproductive impairment in floodplain segments with mean soil PCB concentrations greater than 9 ppm within the nearest 100-ft interval to the river, even though they are assumed to receive integrated exposure over the entire 300-ft width.

p. 71 "... literature suggests that robins forage over greater distances, can travel 1/4 mile in search of food (Howell, 1942) ..."

Response: Most of the literature gives robin territory size much smaller then the fledgling-stage foraging area used In the TERA (USEPA 1993).

c. Although EPA has not done so, areas of "high-quality forested habitat" should be defined and identified prior to recommending a floodplain soil remedial alternative.

p. 72-73 "The habitat assessment performed by Tecumseh demonstrates that most of the immediate floodplain (<u>i.e.,</u> the area within 100 ft of the River) can be considered "high-quality forested habitat" ... The large number of mature tree that line the Upper Sheboygan River floodplain are irreplaceable and provide valuable habitat for feeding, breeding, and/or cover for various wildlife species. The forested strip along the River probably functions as a wildlife corridor allowing wildlife to travel undisturbed through the surrounding developed area. ...Furthermore, the large trees lining the River provide bank stabilization and prevent erosion of floodplain soils."

Response: Trees are renewable resources and are not irreplaceable. Assessment of quality requires consideration of factors in addition to whether trees are present, such as the species of trees present

and the size and connectivity of quality habitats. For example, in at least one of the areas under consideration, the majority of the mature hardwoods are will illows, which are fast-growing, relatively short-lived, and hardly "irreplaceable". Narrow strips of trees along the river bank do have important stabilization properties (although they do not "prevent" erosion), but may have limited breeding habitat quality because of the edge effect that favors nest predation and parasitism. Also, narrow wooded strips serve as corridors for wildlife characteristic of habitat edges, species that are generalists and usually plentiful; but wildlife characteristic of forest interiors, species that are specialists and less common, often will not utilize narrow wooded corridors (Forman 1995).

p. 74 "Even if there were merit to the 5 ppm terrestrial SWAC goal, however, Tecumseh has calculated that removing the top six inches of floodplain soils containing PCBs greater than 42 ppm will yield a floodplain SWAC of 5 ppm (except in FPL-11, where a SWAC of 6 ppm would be achieved based on RI data). ... There is no need to remove soils over 10 ppm to achieve the goal of 5 ppm terrestrial SWAC."

Response: The SWAC calculations are averaged over floodplain areas that greatly exceed the foraging area of robins (or other likely terrestrial vermivorous receptors), and therefore do not represented area-weighted exposures to foraging vermivores. The SWAC analysis provided in the comment applies to a hypothetical vermivore with foraging areas 10 to 35 times larger than robin nestling-stage foraging area, and 2 to 6 times larger than robin fledgling-stage foraging area (Section 6.7).

FS6. EPA must ensure that 10 ppm is the lowest level cleanup feasible while still preserving the integrity of the floodplain habitat.

Response: The National Contingency Plan (NCP) does not require selecting the lowest cleanup feasible. All Superfund remedies must evaluate human health risk and ecological risk. So long as the threshold of overall protectiveness is met, EPA has the ability to balance a number of other factors (including feasibility and habitat) in selecting a remedy.

FS7. Citizens should call for a cleanup plan that protects their families and natural communities first. Only then should payment structures, i.e., cost, be discussed.

Response: Superfund remedies must first meet two threshold criteria.

> ***Overall protection of human health and the environment which determines whether the alternative eliminates, reduces, or controls threat to public health and the environment, and,***
>
> ***Compliance with Applicable or Relevant and Appropriate Requirements (ARARS) which evaluates whether the alternative meets Federal and State environmental statutes, regulations, and other requirements that pertain to the site.***

It is only after these two threshold criteria are met that factors such as long-term effectiveness and permanence, reduction of contaminant toxicity, mobility or volume through treatment, short-term effectiveness, implementability, cost, state acceptance and community acceptance will be considered before a final Superfund remedy is selected

The selected remedy will protect families and the environment to the extent the law allows.

FS8. Kohler Co. agrees with USEPA's statement regarding floodplain soils in the Proposed Plan that states in some localized areas contaminated soil with more than 10 ppm may be left in place to avoid impacts to high-quality forested habitat. Specifically, Flood Plain Areas #6 and #11 contain high-quality habitat and the destructive nature of the proposed alternative (excavation) is not considered appropriate. Several other flood plain areas exist that contain lesser levels of quality habitat (on Kohler Co. property) that may be substituted for the above mentioned areas to achieve a similar level of protection of human health and the environment.

Response: Comment Noted

Groundwater

G1. The US EPA should specify what action it will take if PCB-contaminated groundwater threatens to pollute surface waters and endanger human health and the environment.

Response: The selected remedy calls for an evaluation of PCB-contaminated groundwater at the Tecumseh facility. This evaluation will consider potential impacts of facility groundwater to surface water. Any preferential pathways found between the groundwater and surface water will be removed. If necessary, as stated in the ROD, a collection and treatment trench will be constructed.

Human Health Risks

HH1. Human Health Risk Are Substantially Overstated

a. EPA's HHRA uses an excessive estimate of fish consumption, ignoring site-specific fish consumption data.

"EPA's HHRA is based on excessive estimates of consumption of fish from the Sheboygan River. In evaluating the risk from consumption of fish that contains PCBs, any exposure assessment must consider the amount of fish from the site in question that people actually eat. EPA's HHRA errs by using generic estimates of fish consumption rates, disregarding more accurate site-specific fish consumption rate data developed by Environ and submitted to WDNR."

Response: Since an appropriate assessment of site-specific ingestion rates is a large undertaking and accurately assessing true ingestion is a complex effort that must be done with great care and skill, U.S. EPA guidance and policy have been written on this topic.

The fish ingestion rates used were based on a large, multi-time point analysis of anglers in Michigan (West, 1989 and 1993). Distributions of the ingestion rates from these studies have been published in peer-reviewed journals. The 90th to 95th percentiles of ingestion were used, in accordance with Superfund guidance to estimate a reasonable maximum exposure (RME). A large study that was done by Fiore in Wisconsin (Fiore, 1989) found a somewhat lower ingestion rate than what was found in West (37 g/day vs. 54 g/day). There was also a smaller, less robust study of Sheboygan fishers (Environ) that was done, but the U.S. EPA did not consider this an improved or more accurate estimate of fish consumption for the Sheboygan River. The use of the RME for fish consumption is consistent with the NCP and general risk guidance.

“The Agency for Toxic Substances and Disease Registry (ATSDR) recently sponsored a study of fish consumption from the Sheboygan River that showed very few people eat resident fish from the Sheboygan River."

Response: The U.S. EPA disagrees with the conclusion that very few people eat fish from the Sheboygan River. In fact, the estimates of fish consumption in this study are in line with what was estimated by USEPA. As shown in Table 2 of the ATSDR study (May 1998), 40 percent of those surveyed fished in the River, the highest percentage for any location. In addition, Table 3 shows that 27 meals a year were consumed by Sheboygan anglers (close to what was assessed

as a central tendency estimate in the 1996 analysis) with most being sport fish (trout and bass). The U.S. EPA has used sport fish for the basis of most of its assessments and not non-resident fish like salmon. While trout is somewhat migratory, it does spend signiricant enough time to bioaccumulate PCBs in the Sheboygan River. Lastly, this conclusion does not account for future potential fishing and fish consumption if fish advisories were not in place.

b. EPA's HHRA over represents the line between fish consumption and human PCB body burden.

"... recent studies have found such a correlation (between fish consumption and the human body burden of PCBs) to be weak or nonexistent when examining anglers in areas with relatively high concentrations of PCBs."

Response: The U.S. EPA disagrees that fish consumption is not related to PCB body burdens in humans. While the attachments to this comment (Tecumseh Comment Package, Exhibit 5) contain a large amount of material from other PRPs and other memos to form the basis of this comment, several peer-reviewed scientific journal articles indicate otherwise. There have been several studies of consumers of Lake Michigan fish and also consumers specifically in Wisconsin. All of these studies find a statistical correlation with fish consumption and levels of PCBs in sera. A series of Jacobson articles on a cohort of children whose mothers consumed Lake Michigan fish also show the relationship between fish consumption, PCB levels and neurodevelopmental effects.

c. EPA's HHRA overstates the toxicity of PCBs.

"The 1996 memoranda on which EPA relies used a now-superseded cancer potency factor of 7.7 (mg/kg-day)."

Response: The comment refers to EPA's use of 7.7 as the cancer slope factor in 1996, which was the correct and appropriate factor to use at that time. Since then, U.S. EPA has revised its toxicity factors for PCBs, undergoing public comment, peer review and then published in the Environmental Health Perspectives journal, and the basis is now located on USEPA's Integrated Risk Information System (IRIS). This revised slope factor of 2 <u>was</u> used in calculations of cleanup goals, as appropriate. The upper bound of the high risk and persistence slope factors was chosen in accordance with the new PCB toxicity guidance on IRIS which states that the following are reasons to use the high risk value:

"Criteria for use:
- Food chain exposure
- Sediment or soil ingestion
- Dust or aerosol inhalation
- Dermal exposure, if an absorption factor has been applied
- Presence of dioxin-like, tumor-promoting, or persistent congeners
- Early-life exposure (all pathways and mixtures)"
[from IRIS: http://www.epa.gov/iris/subst/index.html]

Note that for Sheboygan, food chain exposure (via fish) and presence of dioxin-like congeners criteria exist, indicating use of the 2 high risk value.

The comment is less clear about concerns regarding the Reference Dose. The commentor is referred to IRIS for additional information on the Reference Dose, which clearly shows that the animal studies the RfD is based on is not inappropriate. But rather, primates were used for an immunotoxicity endpoint and the results have been repeated in more than study (see Aroclor 1254 in IRIS). Changes to IRIS toxicity factor are done on a national and peer-reviewed fashion and it is not appropriate to alter them based on general concerns raised on a site-specific basis.

"The Food and Drug Administration (FDA) has direct enforcement responsibility for the safety of the U.S. food supply. The FDA establishes and enforces tolerance levels for chemicals in food that are intended to apply to the entire U.S. population. The FDA initially established a tolerance level of 5 ppm in fish and shellfish in 1973, and later revised this tolerance to 2 ppm in 1984."

When the level was lowered to 2 ppm for PCBs in fish (edible portion), the FDA "evaluated the adequacy of a 2 ppm tolerance for fish from the standpoint of the protection of public health, while assessing whether any higher limits could be safely tolerated."

Response: The Food and Drug Administration is responsible for the safety of the food supply and thus also fish sold in commerce. However, they it is responsible for setting State fish advisories. Because the FDA is concerned with commerce, FDA tolerances are based also on impact to commerce, not solely on toxicity and risk. USEPA advises the FDA on tolerance values in order to provide toxicological and risk information. For sport fishing specifically, it's inherently up to the states to provide the best health advice and routinely states have set fish advisories well below FDA's limit of 2 ppm (see footnote of PRP comments which shows WDNR and the

Great Lakes Sport Fish Advisory Task Force levels, which are all below 2 ppm). Overall, then, it is not appropriate to rely solely on FDA limits on fish.

d. EPA failed to use probabilistic methods to estimate risk assessment parameters.

Response: We agree that characterization of uncertainty is an important part of a risk assessment. However, it is not necessary to always use probabilistic methods in risk assessments to characterize this uncertainty. At Sheboygan, we used a semi-quantitative approach to uncertainty was. Several values for key parameters such as ingestion rate were used to help bound the uncertainty. It is important to address data quality before use of a probabilistic analysis at a site, especially for key parameters such as the concentration term for sediment and fish tissue levels of PCBs . Sheboygan's data set has limitations, including having limited geospatial information of sediment levels (i.e., the data are not in GIS or similar platform) and having significant date gaps for certain areas of the site, especially in recent years (i.e., little TOC data). The limitations in understanding well the sediment date at the site introduces uncertainty in the cleanup goal and post-remediation risk calculations. This uncertainty may overshadow any uncertainty introduced by the risk assessment process. Therefore, the data at Sheboygan may not be at a level where probabilistic risk assessment would significantly alter the understanding and decision-making at the site.

e. Even a point estimate shows that an insufficient bases exists for remedial action beyond the alternatives recommended in the FS.

"Given the lack of evidence indicating that the levels of PCBs currently found in Sheboygan River fish present a significant human health risk, the incremental benefit of removing additional amounts of PCBs for particular sections of the river is extremely uncertain. In the face of this uncertainty, EPA should take a risk management approach to river sediments. Under this risk management approach, the incremental benefits and incremental costs of increasingly stringent remedial alternatives must be carefully weighed, and alternatives should be selected that ensure proportionality between incremental costs and incremental environmental benefits."

Response: The U.S. EPA disagrees with the basic promise that the levels of PCBs currently found in the Sheboygan River do not presently represent a significant human health risk. Further, the

NCP rejects the concept of a strict benefit/cost assessment for decision-making.

The U.S. EPA has followed the NCP's approach to the assessing risk, costs, and benefits. Section 300.430(e)(2) of the NCP has defined the risk range from 10^{-4} to 10^{-6}, but sets 10^{-6} as the point of departure for managing risks. Therefore, the selection of any remedy "away" from 10^{-6} point would consider other factors such as long-term effectiveness, short-term effectiveness, cost, etc. The U.S. EPA has carefully weighed all of the alternatives and selected a remedy that is proportional with regards to costs and environmental benefits. The issue of proportionality is discussed in other responses.

HH2. U.S. EPA's cleanup plan must protect women and children because of their unique sensitivities to fish contaminated with PCBs.

Response: The U.S. EPA agrees that it is important to protect sensitive subpopulations, such as women and children. It is important to assess those groups who are most exposed and those who are most susceptible. Wisconsin Dept. of Health and Family Services, in conjunction with the Agency for Toxic Substances and Disease Registry, did an exposure assessment survey of people who consume fish in Sheboygan (May 1998). The study looked at three groups: Hmong residents, women who were in the WIC program, and sport fishers. In looking at the women and children group represented by the WIC group, the exposure to Sheboygan fish was much less than that for the sport fishers. Therefore, the highest intake group was assessed - the sport fisher - and will be quite protective of fish consumption levels of women and children in the area. In addition, the most sensitive and stringent toxicity values were used (including reproductive) to ensure a protective cleanup goal. In this case, cancer was the most protective endpoint and was used in developing a cleanup goal. Therefore, even though women and children may not be explicitly mentioned, they are clearly considered and protected in the risk analyses.

HH3. The plan must cleanup sediments to at least the background level of 0.05 ppm PCBs to ensure it goes as far as is feasible to protect people, including the Hmong.

Response: It is not clear what the true background level of PCBs are in this system or in the State of Wisconsin in general. Instead of using historical levels to remediate the site, USEPA took a risk-based approach, so that different groups, including the Hmong could be assessed In Sheboygan, consumption of fish was considered as the most important pathway and cleanup goals were set to be protective of the high-end potential fishing population, which would protect the current levels of

fishing by the Hmong and increased fishing rates, up to 90 percent or more of levels seen in fishing level studies. This approach is consistent with the NCP.

HH4. Average concentration of PCBs on the riverbotton must consider the actual exposure carp or catfish have to soft sediment areas in the river to ensure protection of human health and the environment, and to accurately reflect cleanup effectiveness.

Response: The risk assessment and cleanup goal analysis did consider the contribution from the soft sediment as well and the rest of the riverbottom (part gravel). The samples from each of the areas were surface-weighted, meaning, they were not averaged indiscriminately, but being representative of a certain area. A straight average was not used, but an average corresponding to each samples areas was used instead. It is not known how much time certain species spend in the soft versus non-soft sediment areas; assessing this aspect of fish behavior would introduce a large degree of uncertainty and was not considered possible given the lack of information **available.**

Carp and catfish were not used to set the cleanup goal because those species are not representative of the diet of those consuming fish from the Sheboygan River. Previous studies indicate (including the WDHFS/ATSDR study) have shown that other species such as salmon are consumed with the greatest frequency. However, to add a level of protection, the cleanup goals were based on consumption of a more contaminated species, the bass, to allow for more fishing in the future of a greater variety of fish, including those more contaminated than ones being consumed now.

<u>Ecological Risks</u>

ECO1. Ecological risks are substantially overstated.

a. The AERA overstates PCB-related risks by failing to account for non-PCB related factors.

Response: The risk assessment clearly states that confounding factors in the triad assessment preclude the derivation of sediment remediation goals based strictly on the benthic assessment. Furthermore, the AERA clearly states that Stations T07, T13, and T19 were impacted based on the Triad analysis, noting the highest compound class at each station. No statement is made in the AERA that attributes the adverse effects to PCBs alone. The PRPs correctly note that the AERA states that the benthic analysis was not

used to derive the sediment contaminant concentrations protective of ecological receptors.

p. 14. "Specifically, the three benthic sampling locations identified as "clearly ... [o]r moderately impacted" (Stations T07, T13, T19) exhibited elevated levels of metals or PAHs rather than uniquely high concentrations of PCBs ... The AERA admitted great uncertainty as to whether risk to benthic invertebrates is attributable to any of the chemicals of concern, stating that "[t]he toxicity in the reference area combined with the relatively low contaminant concentrations suggests the possible importance of unmeasured contaminants."

Response: Station T07 sediment resulted in 100 percent mortality of both Hyalella azteca and Chironomus riparius in sediment toxicity tests, the only sample that exhibited total lethality, and the only site-related sample with statistically greater mortality than reference samples (Table 3-6). This finding is confirmed by field evidence. The benthic survey showed substantial reductions in the total abundance of benthic invertebrates at T07 compared to either reference locations or other site-related locations. Again, the difference with reference locations is statistically significant (Table 3-7). The high toxicity of T07 sediment to benthic organisms, as demonstrated in both field and laboratory investigations, cannot be attributed to either PAHs or metals because the concentrations of PAHs or metals in T07 sediments do not exceed their respective probable effect levels (PELs) (Tables 3-2 and 3-3). Although several PAHs and some metals (Cr, Cu, Hg, Zn) meet or exceed the more conservative threshold effects levels (TELs), modest exceedances of screening-level values are unlikely to result in the severe lethal and pronounced community-level impacts measured at station T07.

Station T07 does have "uniquely high concentrations of PCBs", 760 ppm compared to 2 ppm in the next highest station (T08), and less than 0.03 ppm in the reference stations (Table 3-1). In addition to having the highest sediment PCB concentration, station T07 also has the highest levels of chromium, copper, mercury, and silver of the sample stations. However, none of the metals are likely causes of mortality at T07 because they all occur at concentrations lower than their respective PELs (Table 3-3). Although a silver sediment benchmark is not given in the AERA, the concentration at T07, 0.25 ppm, is well below the 3.7 ppm effects range median (ERM) and 1.0 ppm effects range low (ERL) benchmark values for marine sediments (Long, et al. 1995). The total PAH level at T07 is the lowest of the site-related locations, and is well below both total and individual PAH PELs (Table 3-2). In contrast, the sediment PCB levels at TO7

exceed the PCB PEL by 3 orders of magnitude (Tables 3-1 and 3-5). All lines of evidence of the sediment triad - chemistry, toxicity testing, and field survey - converge to a single conclusion that elevated PCBs at T07 are acutely lethal to benthic invertebrates.

The conclusion that sediment PCB levels of 760 ppm are acutely toxic to benthic invertebrates is not affected by impacts to reference benthos due to postulated unmeasured contaminants because both the toxicity test and benthic survey results were markedly better at the reference stations than at T07. Toxicity test survival was 0 percent for T07 sediments, but ranged from 47 percent to 95 percent for the reference sediments (Table 3-6). Likewise, total benthic abundance in the field was 65 to 82 percent less at T07 compared with reference station abundances (calculated from Table 3-7). This demonstrates that the high sediment PCB concentrations near the site results in severe benthic impacts above and beyond the **stresses** ***on Sheboygan benthos due to other factors unrelated to the site.***

Unfortunately, sediment PCB levels intermediate between 760 and 2 ppm were not collected for toxicity testing or surveyed for field effects. The available evidence does not show adverse effects on benthic invertebrates in sediments with PCB concentrations below 2 ppm.

It should be noted that stations T13 and T19 are identified as impacted in the AERA mainly on the basis of sediment chemistry (Section 3.5.3.2). Sediment lead exceeds its PEL at T13 (Table 3-3), and the highest sediment PAH levels are at station T19 (Table 3-2). The biological effects at these stations, possibly due to metals or PAHs, are minor in comparison with the severe. effects measured at station T07 due to PCBs (Tables 3-6 and 3-7).

p. 15. "... the AERA's conclusion of "clear adverse effects" at Stations T13 and T19 is not supported by the data. For example, at Station T13, toxicity tests showed that organism growth was not statistically different from negative controls or reference site locations (AERA, Table 3-10). Similarly, species richness and abundance at Stations T13 and T19 were not statistically different from negative controls and reference site locations (AERA, Table 3-10). Survival of *H. azteca* was not statistically different from survival reported at reference site locations (AERA, Table 3-10)."

Response: The total biomass growth for T13 was lower than all other site-related and reference locations (except T07 in which no test

organisms survived), but the differences are not statistically significant as noted in the comment. However, growth on an individual basis was, statistically lower at T13 compared with either reference sediments or the negative control. Survival was statistically lower at T13 compared with the negative control (Table 3-6).

Survival in the site-related sediments was second lowest for T19 sediments (behind T07 with no survival), which is statistically different from the negative control. As noted in the PRPs comment, survival rates for T13 and T19 are not statistically different from that of the reference locations.

p. 15 "By failing to explain adequately the other causes of observed sediment toxicity, especially at reference locations with low PCB concentrations, the AERA cannot demonstrate a PCB-related exposure-response relationship, and thus cannot be used to develop a risk mitigation strategy directed at PCBs."

Response: The lethality of PCBs in sediments near the site source (Station T07) is unequivocally demonstrated by both laboratory benthic toxicity tests and by field benthic surveys. The toxicity is strikingly higher at T07 compared with any of the reference stations even though some of the reference station sediments exhibit non-site related adverse effects. The exact cause of the reduced benthic abundance and species diversity in some of the reference locations does not change in any manner the conclusion that the severe toxicity and pronounced decrease in benthic abundance at T07 is caused by highly elevated PCB levels (760 ppm) since the impacts are much more severe at T07 compared with the reference locations, and are consistent with comparisons with sediment PCB benchmarks. The conclusion that sediment PCBs do not result in significant benthic impacts below 2 ppm also is not affected by the reference results. The extremes of the benthic-sediment PCB dose-response relationship are therefore established by the AERA.

p. 15. "... the benthic triad data were inadequate to derive defensible sediment remedial objectives based on the protection of benthic invertebrates."

Response: Benthic data were not used for setting sediment remedial objectives. However, the conclusion that significant benthic effects are not likely under 2 ppm sediment PCB is reasonably consistent with the remedial objectives calculated for protection of piscivores.

b. The AERA overestimates PCB-related risks by using inappropriate toxicity criteria and by failing to field-verify predicted effects.

> ***Response: All of the TRV values used in the AERA were derived from widely respected, peer-reviewed, scientific journals and therefore meet the desired standard of "high-quality studies." NOAA is aware of no evidence presented in the scientific literature indicating that PCB tissue residue effect concentrations differ between fresh and salt water species.***
>
> ***The commentor's discussion of observed fish populations in the Sheboygan River does not consider fish recruitment from outside the study area. In addition, the observed fish population, because of the fish advisory, is not subject to fishing pressure. These factors likely affect the fish population observed.***
>
> ***The 10th and 50th percentile tissue reside effects concentrations noted by the commentor pertain to the endpoint of effects on adult fish. While adult fish may not appear to be experiencing effects, this alone does not mean that the fish population is healthy. As reproduction is a major endpoint of concern, known to be associated with elevated levels of PCBs in tissues, the more appropriate comparison would be to the effects concentrations in eggs and ovaries (0.19 mg/kg eggs and 2.2 mg/kg eggs). Note that the remedial goal for sediment in the Proposed Plan is not based on the derived sediment concentration protective of fish but rather those protective of mammals and birds, representing a higher trophic level risk.***

p. 15-16. "A more appropriate method [than using a variety of studies for estimating effects on fish] would have been to select those TRVs that were most relevant to the receptors at issue, and which were derived from high-quality studies. This approach would have yielded a more realistic site-specific estimate of risks, and would likely have found fewer areas that posed unacceptable risks."

> ***Response: This comment contradicts comment #4 that criticizes the selection of the TRVs for piscivorous wildlife because they rely on studies selected to best represent the toxicity to avian and mammalian piscivores. In direct contradiction, the PRP's criticize the selection of the fish TRVs because they are derived from a large number of toxicity studies, and instead urge a narrower choice of studies for obtaining TRVs. The approach used in the AERA for deriving TRVs is robust - selection of 10th and 50th percentile effect***

levels from a range of studies reduces the uncertainities associated with the results of individual studies.

The claim that "fewer areas that posed unacceptable risks" would have been found if the TRVs were based on selected "high quality studies" "most relevant to the receptors at issue", is speculative.

p.16. "As noted above, the benthic community surveys indicated that effects predicted by sediment toxicity tests and/or conservative sediment screening criteria were not manifested in the field..."

Response: This statement is incorrect. Sediment toxicity test results, field benthic community survey results, and the results of comparisons of sediment PCB levels with <u>non-conservative</u> PELs all lead to the same conclusion for station T07 - that the elevated PCBs in the river near the primary source are highly lethal to benthic invertebrates.

c. The AERA overstates risks to piscivorous wildlife by providing a generic rather than a site-specific evaluation.

Response: The 100 percent residence and forage time on-site assumption is appropriate for herons and mink since the annual time these receptors spend at the site is longer than experimental exposure durations of the toxicity reference value (TRV) studies, as discussed in Section 5.1.1 of the AERA. The toxicity studies used in the AERA were short-term studies with an eight-week exposure duration for the heron (Summer et al 1996) and a twelve-week exposure duration for the mink (Heaton et al 1995). Note that although the avian TRV study duration is 10 weeks, there was a two-week acclimation period before the eight-week PCB exposure was initiated. The adverse effect on heron hatchability was evident after only 5 weeks exposure, which is as little as one-fourth of the typical courting and breeding periods of great blue herons.

Bioavailability estimates were not included in the AERA because the exposure models are based on measured PCB concentrations in prey species. PCBs incorporated in prey tissues have, by definition, been shown to be bioavailable from the prey's environment. Since PCBs are primarily stored in fatty tissues, which are easily digestible, the PCBs in prey are expected to be highly bioavailable to predators feeding on that prey.

PCB levels in mink and heron diets were based on concentration data in appropriate prey species, by river section, which included 89 and 92 percent of the modeled dietary components of mink and heron, respectively (Table 5-3). Unlike a screening-level assessment, the receptors were not assumed to exclusively feed on the most contaminated dietary item at the highest detected concentration. Instead, only contaminant data for the fish size classes suitable for prey were included in the exposure models (excluding the largest and therefore presumably oldest and most contaminated fish from the model). Predators were not assumed to feed only from the most contaminated river sections, but instead risks along different segments of the river were evaluated separately. Also, unlike the procedure followed In screening-level assessments, back-calculations of ecologically protective sediment levels were based on lowest observed adverse effect level (LOAEL) toxicity data, not on no observed adverse effect level (NOAEL) data. These assumptions and procedures are neither "extremely conservative" or "unrealistic."

As noted in the AERA, the riverine studies reviewed indicate that birds and mammals account for less than 10 percent of the mink diet (Table 5.1 AERA), and are therefore, not considered significant contributors to mink exposure. Small mammal data are shown in Table 5-9.

The risk findings of the AERA are consistent with the absence of mink along the river in habitat that is expected to support a "moderate wild mink population". Section 2.2.4 of the AERA notes, "mink populations are well below what would normally be expected for the available habitat, and in fact no mink were captured during a trapping study conducted along the river." This is one line of field evidence that supports the risk conclusions of the AERA.

d. The AERA used inappropriate TRVs to evaluate risks to piscivorous wildlife.

Response: As chickens are known to be more sensitive to PCBs than other species investigated so far in laboratory studies, no inter-species uncertainty factor was used for deriving risk estimates for heron.

The pesticides present in the Saginaw carp used in the toxicity studies are at levels well below those expected to produce adverse reproductive effects as noted in Heaton, et al. (1995). There are low-levels of dioxins and furans in the Saginaw carp, but this is also true

for the contamination in the Sheboygan River sediments; therefore, use of the subject studies is appropriate for risk estimation at the Sheboygan site. Heaton et al also notes that the observed effects in the study are consistent with known effects due to PCB exposure. There are no indications of metal-induced reproductive toxicity.

The mink LOAEL TRV of 0.15 mg PCBs/kg$_{BW}$-d derived from Heaton, et al. (1995) is consistent with mink reproductive LOAELs based on Platonow and Karstad (1973), Hornshaw, et al. (1983), and Wren et al (1987); and is an order of magnitude greater than the LOAEL based on den Boer (1984) (see USEPA 1995 for LOAEL calculations). The study most similar to Heaton et al. (1995) reported a higher NOAEL for mink fed Great Lakes fish (Hornshaw, et al., 1983), 0.015 and 0.032 mg PCBs/kg$_{BW}$-d, respectively. However, consistent (but not statistically significant) decrements in litter size and pup weights were detected at the NOAEL, and the lead investigator is of the opinion that a study with greater statistical power would likely show effects at doses lower than the reported NOAEL (Tom Hornshaw pers. comm. to James Chapman, USEPA, 7/12/99).

The avian LOAEL TRV of 0.4 mg PCBs/kg$_{BW}$-d derived from Summer et al (1996) is consistent with reproductive LOAELs based on Britton and Huston (1973), Platonow and Reinhart (1973), and Scott (1977) [0.67, 0.34 and 0. 67 mg PCBs/kg$_{BW}$-d, respectively] (see USEPA 1995 for LOAEL calculations - the Britton and Huston NOAEL is mistyped in Table 4-6, see text for correct value and basis for LOAEL calculation). Note that the LOAELs calculated by USEPA (1995) are much lower than the values reported in the RP's comments. The reproductive LOAELs based on Lillie, et al. (1974) and Dahlgren, et al. (1972) are higher [1.3 and 1.8 mg PCBs/kg$_{BW}$-d, respectively], although the LOAEL for chick growth in the Lillie et al study is lower than the LOAEL used in the AERA [0.13 mg PCBs/kg$_{WB}$-d. Again, note the substantial (order of magnitude) discrepancy between the LOAEL calculations performed by USEPA (1995) and the RPs.

The comment regarding the derivation of TRVs using inconsistent TEF systems in the TEQ calculations is incorrect. The AERA notes on page 90 that the conversion to a consistent TEQ basis was performed in order to avoid comparison of inconsistent TEP systems.

p. 18-19. "As an alternate approach for the selection of TRVs, additional studies on PCB toxicity should have been considered. For mink, the results from a number of studies are available, and each may provide potentially useful data for evaluating the effects of PCBs on mink. ... [S]everal studies have been conducted on chickens, the species that provides the basis for the TRVs used in the AERA. ... In addition, the effects of PCBs on other bird species have been studied. These data also should have been considered in the AERA."

Response: This directly contradicts and earlier comment that criticizes the fish TRV derivation because it relied on a variety of studies.

ECO2. US EPA's proposed cleanup needs to go further to adequately protect the environment.

Response: CERCLA gives the U.S. EPA the authority to react and remediate imminent and substantial endangerment to human health and the environment. The U.S. EPA has selected a remedy that mitigates imminent and substantial endangerment to human health and the environment.

Appendix B - State Letter of Non-Concurrence

Appendix C - Administrative Record Index

APPENDIX C

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL ACTION

ADMINISTRATIVE RECORD
FOR
SHEBOYGAN RIVER AND HARBOR
SHEBOYGAN COUNTY, WISCONSIN

UPDATE #5
MAY 8, 2000

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	08/02/94	Foster, D., Blasland, Bouck & Lee, Inc.	Hughes, D., Hughes Consulting	Letter re: Dredging Activities and Associated Costs at the Sheboygan River and Harbor Site	6
2	11/15/94	Foster, D., Blasland, Bouck & Lee, Inc.	Eleder, B., U.S. EPA	Letter Forwarding Fish Consumption Survey Reports for Fall 1993 and Spring 1994 for the Sheboygan River	71
3	05/17/95	Foster, D., Blasland, Bouck & Lee, Inc.	Eleder, B., U.S. EPA	Annual Interim Monitoring 1994 Progress Report for the Sheboygan River and Harbor Site	12
4	08/00/95	ENVIRON Corporation	Tecumseh Products Company	Risk Assessment Report for the Sheboygan River	167
5	09/15/95	Foster, D., Blasland, Bouck & Lee, Inc.	Eleder, B., U.S. EPA	Letter Forwarding Draft Table of Contents for the Sheboygan River and Harbor Feasibility Study	2
6	10/00/95	Blasland, Bouck & Lee, Inc.	Tecumseh Products Company	Alternative Specific Remedial Investigation Report for the Sheboygan River and Harbor Site: Volume 1 of 4 (Text, Tables and Figures)	485
7	10/00/95	Blasland, Bouck & Lee, Inc.	Tecumseh Products Company	Alternative Specific Remedial Investigation Report for the Sheboygan River and Harbor Site: Volume 2 of 4 (Appendices A through F-6)	491

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
8	10/00/95	Blasland, Bouck & Lee, Inc.	Tecumseh Products Company	Alternative Specific Remedial Investigation Report for the Sheboygan River and Harbor Site: Volume 3 of 4 (Appendices F-7 through F-10)	526
9	10/00/95	Blasland, Bouck, & Lee, Inc.	Tecumseh Products Company	Alternative Specific Remedial Investigation Report for the Sheboygan River and Harbor Site: Volume 4 of 4 (Appendices F-11 through H-1)	312
10	01/17/96	Foster, D., Blasland, Bouck & Lee, Inc.	Padovani, S., U.S. EPA	Letter re: WDNR's Sediment Quality Criteria as Cleanup Objectives for the Sheboygan River and Harbor Site	20
11	06/07/96	Foster, D., Blasland, Bouck & Lee, Inc,	Padovani, S., U.S. EPA	Annual Interim Monitoring 1995 Progress Report for the Sheboygan River and Harbor Site	13
12	06/12/96	Foster, D., Blasland, Bouck & Lee, Inc.	Padovani, S., U.S. EPA	Monthly Status Report for May 1996 for the Sheboygan River and Harbor Alternative Specific Remedial Investigation	23
13	08/15/97	Foster, D., Blasland, Bouck & Lee, Inc.	Padovani, S., U.S. EPA	Annual Interim Monitoring 1996 Progress Report for the Sheboygan River and Harbor Site	16
14	02/11/98	Petri, T. & N. Smith; U.S. Congress	Browner, C., U.S. EPA & B. Babbitt, U.S. DOI	Letter re: Comprehensive Cleanup Settlement for the Sheboygan River and Harbor Site	2
15	08/31/98	Foster, D., Blasland, Bouck & Lee, Inc.	Padovani, S., U.S. EPA	Annual Interim Monitoring 1997 Progress Report for the Sheboygan River and Harbor Site	14
16	11/25/98	Feingold, R., et al; U.S. Senate & Sensenbrenner, F., et al., U.S. Congress	Muno, W., U.S. EPA	Letter re: Request for Additional Information on the Status of the Remediation of the Sheboygan River and Harbor Superfund Site	2

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
17	12/11/98	Ullrich, D., U.S. EPA	Sensenbrenner, F., U.S. Congress	Letter re: U.S. EPA's Response to November 25 1998 Letter Concerning the Status of Remediation at the Sheboygan River and Harbor Superfund Site	2
18	12/30/98	Hohreiter, D., Blasland, Bouck & Lee, Inc.	Ryan, T. & S. Galarneau, WDNR	Letter re: Sheboygan River and Harbor Interim Monitoring Program Evaluation	6
19	00/00/99	Sheboygan Outdoor Club	U.S. EPA	Memorandum re: SOC's Comments on the Proposed Plan for the Sheboygan River and Harbor Site	2
20	00/00/99	Ulezelski, T., et al.; Sheboygan County Conservation Association	U.S. EPA	Memorandum re: SCCA's General Statement Concerning the Cleanup of the Sheboygan River	1
21	01/25/99	Hohreiter, D., Blasland, Bouck & Lee, Inc.	Galarneau, S., WDNR	Letter re: 1998 Interim Monitoring Program Resident Fish Data for the Sheboygan River and Harbor w/Attached Tables	4
22	02/00/99	Blasland, Bouck & Lee, Inc.	U.S. EPA	1998 Interim Monitoring Program: Fish Monitoring Data Review Report for the Sheboygan River and Harbor Site	40
23	04/27/99	Foster, D., Blasland, Bouck & Lee, Lee, Inc.	Short, T., U.S. EPA	Letter re: Development and Evaluation of Upper River Alternatives for the Sheboygan River and Harbor Site	5
24	05/13/99	Foster, D., Blasland, Bouck & Lee, Inc.	Short, T., U.S. EPA	Monthly Status Report for April 1999 for the Sheboygan River and Harbor Remedial Investigation/ Feasibility Study	13
25	06/01/99	De Vault, D., U.S. DOI/Fish & Wildlife Service	Short, T., U.S. EPA	Letter re: FWS's Comments to U.S. EPA's Request for Input Pertaining to the Proposed Plan for the Sheboygan River and Harbor Site	2

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
26	06/10/99	Sheboygan Yacht Club	U.S. EPA	Resolution of the General Membership of the Sheboygan Yacht Club Concerning the Sheboygan River and Harbor Cleanup	2
27	6/14/99	Foster, D., Blasland, Bouck & Lee, Inc.	U. S. EPA	Monthly Status Report for May 1999 for the Sheboygan River and Harbor Remedial Investigation/Feasibility Study	86
28	06/30/99	WDNR	U.S. EPA	WDNR Statement at the at the June 30, 1999 Public Hearing re: the Sheboygan River and Harbor Site	2
29	07/23/99	Mueller, K. & S. Wunsch; Sheboygan Area Great Lakes Sport Fishermen	Pastor, S., U.S. EPA/OPA	Letter re: SAGLSF’s Comments on the Proposed Plan for the Sheboygan River and Harbor Site	2
30	08/02/99	Kuehlmann, T., Sheboygan County Chamber of Commerce	Short, T., U.S. EPA	Letter re: Chamber of Commerce's Statement of Position in Support of Feasibility Study	2
31	08/03/99	Dulong, D., U.S. Army Corps of Engineers/ Detroit District	Short, T., U.S. EPA	Letter re: USACOE's Comments on the Proposed Plan for Cleanup at the Sheboygan River and Harbor Site	3
32	08/03/99	Lorenz, T., Sierra Club-Algonquin Shores Group	Pastor, S., U.S. EPA/OPA	Letter re: Sierra Club's Review of a Proposed Plan to Cleanup the Sheboygan River and Harbor	3
33	08/04/99	Sebald, R., The Izaak Walton League of America	Pastor, S., U.S. EPA/OPA	Letter re: IWLA's Comments on the Proposed Plan for Cleanup of the Sheboygan River and Harbor Site	1
34	08/10/99	Petersen, B., et al; Sheboygan County	Pastor, S., U.S. EPA/OPA	Letter re: Sheboygan County’s Support for U.S. EPA’s Preferred Cleanup Plan for the Sheboygan	2

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
35	08/10/99	Tecumseh Products	Tecumseh Products Employees	Letter re: Extension of Public Comment Period for the Sheboygan River and Harbor Site	7
36	08/11/99	McClellan, B., Lake Michigan Federation	Lyons, F., U.S. EPA	Letter re: LMF's Public Comments on the U.S. EPA Proposed Plan for Cleanup of the Sheboygan River and Harbor Site	23
37	08/12/99	Wentland, T., WDNR	Short, T., U.S. EPA	Letter re: WDNR's Comments on the Proposed Plan for the Sheboygan River and Harbor Site w/Attachment	8
38	08/13/99	Blasland, Bouck & Lee, Inc.	U S. EPA	Comments of Tecumseh Products Company on the Proposed Remedial Action Plan for the Sheboygan River and Harbor Site	92
39	08/13/99	Blasland, Bouck & Lee, Inc.	U.S. EPA	Comments of Tecumseh Products Company on the Proposed Remedial Action Plan for the Sheboygan River and Harbor Site: Volume 1 of 6 (Exhibits 1-5: Attachment A)	150
40	08/13/99	Blasland, Bouck & Lee, Inc.	U.S. EPA	Comments of Tecumseh Products Company on the Proposed Remedial Action Plan for the Sheboygan River and Harbor Site: Volume 2 of 6 (Exhibit 5: Attachment B, Exhibits 1-3)	294
41	08/13/99	Blasland, Bouck & Lee, Inc.	U.S. EPA	Comments of Tecumseh Products Company on the Proposed Remedial Action Plan for the Sheboygan River and Harbor Site: Volume 3 of 6 (Exhibit 5: Attachment B, Exhibits 4-7)	299

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
42	08/13/99	Blasland, Bouck & Lee, Inc.	U.S. EPA	Comments of Tecumseh Products Company on the Proposed Remedial Action Plan for the Sheboygan River and Harbor Site: Volume 4 of 6 (Exhibit 6: Attachments C-E)	221
43	08/13/99	Blasland, Bouck & Lee, Inc.	U.S. EPA	Comments of Tecumseh Products Company on the Proposed Remedial Action Plan for the Sheboygan River and Harbor Site: Volume 5 of 6 (Exhibits 6-9)	356
44	08/13/99	Blasland, Bouck & Lee, Inc.	U.S. EPA	Comments of Tecumseh Products Company on the Proposed Remedial Action Plan for the Sheboygan River and Harbor Site: Volume 6 of 6 (Exhibits 10-19)	207
45	08/13/99	Kohler Company	U.S. EPA	Kohler's Comments on the Proposed Plan for Cleanup at the Sheboygan River and Harbor Site	3
46	08/16/99	Concerned Citizens	U.S. EPA	Letters re: Citizens' Comments on the Proposed Plan for the Sheboygan River and Harbor Site Received Between May 30-August 16, 1999	26
47	08/17/99	McClellan, B., et al., Lake Michigan Federation	Lyons, F., U.S. EPA	Letter re: LMF's Addendum to Comments on the U.S. EPA Proposed Plan for Cleanup of the Sheboygan River and Harbor Site	2
48	09/02/99	Baker, J., DecisionQuest EIM	Short, T., U.S. EPA	Four Letters Forwarding Attached Comment Cards in Support of the Feasibility Study Recommended A1ternative for the Sheboygan River and Harbor Site (Received August 13-September 2, 1999).	24

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
49	09/13/99	Trainor, D., Dames & Moore	Pastor, S., U.S. EPA/OPA	Letter Forwarding Attached Thomas Industries' Comments on the Proposed Remedial Plan for the Sheboygan River and Harbor Site	15
50	09/27/99	Schweiger, D., U.S. Army Corps of Engineers/ Detroit District	Short, T., U.S. EPA	Letter re: USACOE's Comments on the Report: *Sheboygan River and Harbor The Potential for Recreational Watercraft to Affect Sediment in the Sheboygan Inner Harbor*	3
51	03/06/00	Short, T., U.S. EPA	AR File	Memorandum re: PCB Concentration Distribution in the Sheboygan Inner Harbor	24
52	03/06/00	Short, T., U.S. EPA	AR File	Memorandum re: Inner Harbor Bathymetry Analysis, for the Sheboygan River and Harbor Site	11
53	03/14/00	Short, T., U.S. EPA	AR File	Memorandum re: Trigger for Excavating PCB-Contaminated Sediments in the Lower River and Inner Harbor at the Sheboygan River and Harbor Site	3
54	03/23/00	Short, T., U.S. EPA	AR File	Memorandum re: Sheboygan Inner Harbor Proposed Sampling Design Approach	3
55	04/10/00	Short, T., U.S. EPA	AR File	Memorandum re: Evaluation of Various Upper River SWAC and PCB Mass Target Approaches for the Sheboygan River and Harbor Site	60
56	04/14/00	Short, T., U.S. EPA	AR File	Memorandum re: Lake Michigan-Huron Water Levels and 1999 Bathymetry Survey for Sheboygan Inner Harbor	3
57	04/18/00	Short, T., U.S. EPA	AR File	Memorandum re: Soft Sediment PCB Concentration Levels and Associated Cancer and Non-Cancer Risks	3

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
58	04/19/00	Short, T., U.S. EPA	AR File	Memorandum Entering Attached Comment Cards Received During Public Comment Period into the Administrative Record for the Sheboygan River and Harbor Site	128
59	04/20/00	Muno, W., U.S. EPA	Means, B., National Remedy Review Board	Memorandum re: NRRB's Recommendations for the Sheboygan River and Harbor Superfund Site	9
60	04/20/00	Nagle, R., U.S. EPA	Short, T., U.S. EPA	Memorandum re: State Water Quality Standards as ARARs for Sediment Sites	2
61	04/20/00	Nagle, R., U.S. EPA	Short, T., U.S. EPA	Memorandum re: Sheboygan ROD Compliance with FY2000 Appropriations Language on Sediment Dredging	3
62	05/01/00	Mucha, A., U.S. EPA	Short, T., U.S. EPA	Memorandum re: Explanation of Cleanup Goal Revisions for the Sheboygan Superfund Site	3
63	05/02/00	Short, T., U.S. EPA	AR File	Memorandum re: Trigger for Excavating PCB-Contaminated Sediments in the Lower River and Inner Harbor at the Sheboygan River and Harbor Site	3
64	05/05/00	Short, T., U.S. EPA	AR File	Memorandum re: Evaluation of Various Upper River SWAC and PCB Mass Target Approaches for the Sheboygan River and Harbor Site	96
65	05/05/00	Short, T., U.S. EPA	AR File	Memorandum re: PCB Fish Tissue Concentrations for Bass, Walleye, Trout, Carp and Catfish Based on a Sediment Cleanup Goal of 0.5 ppm for the Sheboygan River and Harbor Site	2

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
66	05/05/00	Short, T., U.S. EPA	AR File	Memorandum re: Sediment Cleanup Goals Based on Bass and Carp for the Sheboygan River and Harbor Site	2

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL ACTION

ADMINISTRATIVE RECORD
FOR
SHEBOYGAN RIVER & HARBOR SITE
SHEBOYGAN, WISCONSIN

UPDATE #4
AUGUST 10, 1999

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	05/27/99	U.S. EPA	Public	Public Notice Announcing (1) June 1-30, 1999 Public Comment Period re: the Feasibility Study/Proposed Plan for the Sheboygan River and Harbor Site and (2) the June 30, 1999 Public Meeting (*Sheboygan Press*)	1
2	06/24/99	U.S. EPA	Public	Public Notice Announcing the June 30, 1999 Public Meeting re: the Proposed Cleanup Plan for the Sheboygan River and Harbor Site (*Sheboygan Press*)	1
3	06/30/99	Mallman & Bastyr Court Reporters	U.S. EPA	Public Meeting Transcript re: the Proposed Plan for Cleanup of the Sheboygan River and Harbor Site	23
4	07/00/99	U.S. EPA/ Region 5	Public	Fact Sheet: *The Sheboygan River and Harbor Proposal is Still Available...and the Comment Period Has Been Extended.*	2
5	07/00/99	Tecumseh Products Company	Public	Sheboygan River & Harbor Superfund Site Community Newsletter	6
6	07/15/99	Foster, D., Blasland, Bouck & Lee, Inc.	Short, T. U.S. EPA	June 1999 Monthly Status Report re: the Sheboygan River and Harbor Remedial Investigation/Feasibility Study	189
7	07/21/99	Short, T., U.S. EPA	File	Conversation Record re: Depths Needed for Unimpeded Navigation at the Sheboygan River and Harbor Site	1
8	07/23/99	Short, T., U.S. EPA	Administrative Record	Memorandum re: Revised Navigation Depth Cost Estimate for Excavation of Contaminated Sediments in the Inner Harbor at the Sheboygan River & Harbor Site	11

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
9	07/26/99	Short, T., U.S. EPA	Briot, J., Blasland, Bouck & Lee, Inc.	Memorandum re: Response to Questions Concerning Administrative Record Item #44 - Inner Harbor Depth Interval Calculations for the Sheboygan River and Harbor Site	9

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL ACTION

ADMINISTRATIVE RECORD
FOR
SHEBOYGAN HARBOR & RIVER SITE
SHEBOYGAN, WISCONSIN

UPDATE #3
JUNE 9, 1999

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	04/00/98	Blasland, Bouck & Lee, Inc.	U.S. EPA	*Feasibility Study Report: Volume I (Text, Tables and Figures)* for the Sheboygan River and Harbor Site	306
2	04/00/98	Blasland, Bouck & Lee, Inc.	U.S. EPA	*Feasibility Study Report: Volume II (Appendices)* for the Sheboygan River and Harbor Site	418
3	04/00/98	Blasland, Bouck & Lee, Inc.	U.S. EPA	*Sediment Transport Study* for the Sheboygan River and Harbor Site	66
4	05/00/98	USDHHS/ATSDR	U.S. EPA	*Fish Consumption Exposure Assessment Study* for the Sheboygan River and Harbor Site	62
5	07/30/98	Nehls-Lowe, H. & C. Warzech; Wisconsin Department of Health & Family Services (WDHFS)	Wentland, T. & C. Krohn; WDNR	Fax Transmission re: WDHFS Input Concerning Public Health Issues Related to Clean-up Activities at the Sheboygan River and Harbor Site	3
6	10/28/98	Sheboygan County Board of Supervisors' Land Conservation & Resources Committees	U.S. EPA/WDNR	Letter: Committee's Support of Tecumseh Products' Most Recent Cleanup Plan for the Sheboygan River and Harbor Superfund Sites	1
7	11/00/98	National Oceanic and Atmospheric Administration / EVS Environment Consultants, Inc.	U.S. EPA	*Aquatic Ecological Risk Assessment: Volume 1 of 3 (Text)* for the Sheboygan River and Harbor Site	142

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
8	11/00/98	National Oceanic and Atmospheric Administration /EVS Environment Consultants, Inc.	U.S. EPA	*Aquatic Ecological Risk Assessment: Volume 2 of 3 (Figures and Tables)* for the Sheboygan River and Harbor Site	138
9	11/00/98	National Oceanic and Atmospheric Administration /EVS Environment Consultants, Inc.	U.S. EPA	*Aquatic Ecological Risk 404 Volume 3 of 3 (Appendices A-J)* for the Sheboygan River and Harbor Site	404
10	11/00/98	U.S. EPA	Public	Fact Sheet: *Feasibility Study Nears Completion for Sheboygan River Harbor Superfund Site*	4
11	11/13/98	Foster, D.; Blasland, Bouck & Lee	Padovani, S. & T. Short; U.S. EPA	Letter re: Methodology for Calculating Surface Weighted Average Concentration (SWAC) for the Sheboygan River and Harbor Project w/ Attached Sampling Data	44
12	11/16/98	DeKeyser, K., Tecumseh Products Company	Padovani, S., U. S. EPA	Letter: Disposal of CTF/ SMF Sediments-Wisconsin Landfill Experience	2
13	01/00/99	U.S. EPA	Public	Fact Sheet: *Feasibility Study Completed for the Sheboygan River and Harbor Site*	2
14	01/11/99	Short, T., U.S. EPA	DeKeyser, K., Tecumseh Products Company	Letter: U.S. EPA/WDNR's Review and Comments on the April 1998 Revised Feasibility Study Report for the Sheboygan River and Harbor Site	2
15	01/11/99	Ruppel, J., WDNR	Short, T., U.S. EPA	Letter Forwarding Attached Graphics Summarizing Analysis of the Sheboygan River and Harbor Feasibility Study Report	32

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
16	01/19/99	Pfarrer, R., Kohler Co.	Short, T., U.S. EPA	Letter re: Kohler's Opposition to Total Mass Removal of All Sediments in the Upper Sheboygan River w/Attached Map	3
17	01/26/99	Chapman, J., U.S. EPA	Short, T., U.S. EPA	Memorandum re: Floodplain Surface Area Weighted Concentrations (SWAC) for the Sheboygan River	3
18	01/27/99	Chapman, J., U.S. EPA	Short, T., U.S. EPA	Memorandum re: Summary of Terrestrial Ecological Risk Assessment Results for Floodplain Soils at the Sheboygan River & Harbor Site	2
19	02/00/99	Blasland, Bouck & Lee, Inc.	U.S. EPA	Report: *1998 Interim Monitoring Program: Fish Monitoring Data Review* for the Sheboygan River and Harbor Site	39
20	02/04/99	DeKeyser, K., Tecumseh Products Company	Short, T., U.S. EPA	Letter re: Sheboygan River & Harbor IMP Fish Data	2
21	02/23/99	Nehls-Lowe, H., WDHFS	Short, T., U.S. EPA	Letter: WDHFS' Comments on the Most Recent Draft of the Remedy Selection Briefing Package for the Sheboygan River & Harbor Site	2
22	03/03/99	Jawetz, S.; *Beveridge & Diamond, P.C.*	Short, T., U.S. EPA	Letter: Tecumseh Products' Submission to the National Remedy Review Board (NRRB) Concerning the Conceptual Remedy Proposed by the U.S. EPA for the Sheboygan River and Harbor Site	11
23	03/04/99	Wentland, T., WDNR	Short, T., U.S. EPA	Letter: WDNR's Comments on the NRRB's Remedy Selection Briefing Package for the Sheboygan River and Harbor Superfund Site	6
24	03/08/99	Tussler, M., BT2, Inc.	Short, T., U.S. EPA	Letter: BT2's Comments on the NRRB's Package for the Sheboygan River and Harbor Site	

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
25	03/11/99	Short, T., U.S. EPA	U.S. EPA	National Remedy Review Board Remedy Selection Briefing Package for the Sheboygan River and Harbor Site w/ Attached Maps	50
26	03/11/99	U.S. EPA/ Region 5	U.S. EPA	*A Human Health Eco-logical Risk and Cleanup Goal Analysis of PCB Contamination in the Sheboygan River & Harbor*	28
27	03/17/99	McDonald, D., Tecumseh Products	Muno, W., U.S. EPA	Letter Concerning the March 4,1999 Meeting w/ Attached March 8, 1999 *Sheboygan Press* "Letter to the Editor:" *Tecumseh Deserves Kudos for River Cleanup Proposals*	2
28	03/22/99	Tecumseh Products Company	Sheboygan Community	*Sheboygan River & Harbor Superfund Site Community Newsletter* (Winter 1999)	6
29	03/31/99	Foster, D., Blasland, Bouck & Lee, Inc.	Short, T., U.S. EPA	Letter: Tecumseh Products' Responses/Clarifications to Topics Raised by the National Remedy Review Board at the March 11, 1999 Meeting	17
30	04/07/99	Chapman, J., U.S. EPA	U.S. EPA	Report: *Terrestrial Eco-logical Risk Assessment* for the Sheboygan River and Harbor Superfund Site **(DRAFT)**	131
31	04/13/99	Foster, D., Blasland, Bouck & Lee, Inc.	Short, T., U.S. EPA	Letter: Tecumseh Products' Responses/Clarifications to Several NRRB Topics	3
32	04/27/99	Foster, D., Blasland, Bouck & Lee, Inc.	Short, T., U.S. EPA	Letter: Review of BBL's Approach to Development of Remedial Alternatives for the Sheboygan River and Harbor Site	3
33	04/29/99	DeKeyser, K., Tecumseh Products Company	Short, T., U.S. EPA	Cover Letter Forwarding Copies of Comment Cards Received as a Result of Tecumseh's Winter 1999 Community Newsletter	49

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
34	05/00/99	U.S. EPA	Public	Fact Sheet: *Proposed Plan for Cleanup of the Sheboygan River and Harbor Superfund Site*	12
35	05/13/99	DeKeyser, K., Tecumseh Products Company	Short, T., U.S. EPA	Cover Letter Forwarding Copies of Additional Comment Cards Received as a Result of Tecumseh's Winter 1999 Community Newsletter	6
36	05/14/99	Short, T., U.S. EPA	Administrative Record	Memorandum re: Upper River Surface Weighted Average Concentration (SWAC) Calculations for the Sheboygan River and Harbor Site	4
37	05/14/99	Short, T., U.S. EPA	Administrative Record	Memorandum re: EPA Risk Calculations for FS Upper River Alternatives 3-IV and 3-IV-A at the Sheboygan River and Harbor Site	2
38	05/14/99	Short, T., U.S. EPA	Administrative Record	Memorandum re: PCB Half-Life Analysis for the Sheboygan River and Harbor Site	18
39	05/14/99	Short, T., U.S. EPA	Administrative Record	Memorandum re: Inner Harbor PCB Concentrations at Various Depths for the Sheboygan River and Harbor Site	18
40	05/14/99	Short, T., U.S. EPA	Administrative Record	Memorandum re: USACE’s 1998 Bathymetric Survey the Inner Harbor at the Sheboygan River and Harbor Site	3
41	05/14/99	Short, T., U.S. EPA	Administrative Record	Memorandum re: Smallmouth Bass Information Provided by Blasland, Bouck & Lee for the Sheboygan River and Harbor Site	3
42	05/14/99	Short, T., U.S. EPA	Administrative Record	USACE’s Construction Cost Estimate for Dredging of the Lower River and Inner Harbor at the Sheboygan River and Harbor Site	

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
43	05/14/99	Short, T., U.S. EPA	Administrative Record	Memorandum: Maximum PCB Concentrations, Sediment Volume and PCB Mass Calculations for the Inner Harbor at the Sheboygan River and Harbor Site	2
44	05/14/99	Short, T., U.S. EPA	Administrative Record	Memorandum: Inner Harbor Depth Interval Calculations for the Sheboygan River and Harbor Site	3
45	05/14/99	Short, T., U.S. EPA	Administrative Record	Memorandum re: Safe Navigational Depth Cost Estimate for Excavation of Contaminated Sediments in the Inner Harbor at the Sheboygan River and Harbor Site	4
46	05/21/99	Muno, W., U.S. EPA	Means, B., U.S. EPA	Memorandum re: National Remedy Review Board Recommendations for the Sheboygan River and Harbor Superfund Site	10
47	05/24/99	Wentland, T., WDNR	Short, T., U.S. EPA	Letter re: WDNR's Middle River Concerns and Cost Estimates for Alternatives I-V and 3-IV-A for the Sheboygan River and Harbor Site w/ Attachments	19
48	05/28/99	W.F. Baird & Associates Coastal Engineers, Ltd.	U.S. Army Corps of Engineers/ Detroit District	Report: *Sediment Trap Assessment on Sheboygan River and Harbor*	22
49	06/02/99	DeKeyser, K., Tecumseh Products Company	Short, T., U.S. EPA	Cover Letter Forwarding Copies of Additional Comment Cards Received as Company a Result of Tecumseh’s Winter 1999 Community Newsletter	2
50	06/03/99	Short, T., U.S. EPA	Administrative Record	Memorandum re: Points of Clarification for the Proposed Plan for Cleanup of the Sheboygan River and Harbor Site	2